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# NUCLEAR SCIENCE ABSTRACTS

Volume 9

January 15, 1955

No. 1

## INTRODUCTION

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A Publication of the United States Atomic Energy Commission Technical Information Service

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*Nuclear Science Abstracts (NSA)* is issued twice a month by the Atomic Energy Commission (AEC). It is intended primarily to serve scientists and engineers working within the Atomic Energy Project, by abstracting as completely and as promptly as possible the literature of nuclear science and engineering. It covers not only unclassified and declassified research reports of the AEC and its contractors, but also material in its field of interest which appears in unpublished research reports of government agencies, universities, and industrial research establishments, and in the technical and scientific journals.

### DECLASSIFICATION

The issuance of these abstracts does not constitute authority for declassification of any reports.

### INDEXES

*Nuclear Science Abstracts* is indexed by personal and corporate author, by subject, and by report number. Annual index issues are prepared for each volume. A cumulated index to Volumes 1-4 was issued as Volume 4, No. 24B, Dec. 30, 1950, covering authors, subjects, nuclides, and report numbers. The 24th number of Volumes 5, 6, and 7 contains indexes covering the individual volumes, as well as a cumulated Numerical Index of Reports covering *Abstracts of Declassified Documents (ADD)*, Vols. 1 and 2, and the previously issued NSA volumes. Issue 24A of Vol. 8 contains author and subject indexes and a Numerical Index of Reports for items abstracted in Vol. 8. A separate publication (TID-4000, Cumulated List of Available Unclassified AEC Reports) which will contain a Numerical Index of Reports cumulated through Vol. 8 of NSA is in preparation.

Each issue of Vol. 9 (1955) contains an Author Index and a Numerical Index of Reports for abstracts in that issue as well as new availability information on reports abstracted previously. Subject and author indexes, as well as a cumulation of the Numerical Index of Reports, covering three-month periods are issued as supplements to the sixth, twelfth, and eighteenth issues. The 24th issue will be the annual index for the volume.

In addition to abstracts, NSA carries in issues 6B, 12B, 18B, and 24B lists of New Nuclear Data in which experimental results are displayed in tabular form and arranged by element and isotope, with each entry including a reference. In 1954 these lists will be cumulated in Vol. 8, No. 24B. The lists of New Nuclear Data are compiled by the Nuclear Data Group of the National Research Council, Washington 25, D. C. The New Nuclear Data items are also supplied by this group on 3 x 5 in. cards for \$20.00 a year domestic and about \$30.00 a year foreign (air mail postage included).

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## ERRATUM

Pages Index 7 and 8 which were included in Nuclear Science Abstracts Vol. 8, No. 18B by error should be removed and placed in Vol. 8, No. 21 following page Index 6 as they are a continuation of the Numerical Index of Reports in that issue.





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## GENERAL

1

RAND Corp.

**ELECTRONIC RELIABILITY AND SUPPLY IMPROVEMENT BASED ON FAILURE REPORTING AND PRESENTATION.** F. A. Hadden and L. W. Sepmeyer. May 25, 1954. 61p. (RM-1257(RAND))

A system for reporting field failures of industrial equipment, providing for the reliable coordination of such information, is described. The procedures worked out in this report are applied specifically to electronic equipment, but the concepts involved are sufficiently broad for other applications. (K.S.)

## ATOMIC POWER

2

North American Aviation, Inc.

**POWER CONVERSION IN NUCLEAR POWER PLANTS.**

T. T. Shimazaki and C. H. Robbins. Aug. 15, 1954. 54p. Contract AT-11-1-GEN-8. (NAA-SR-278)

The design of a central station power plant with a nuclear reactor as the heat source involves an optimization of a group of variables for minimum power cost. For a central station steam power plant with a fixed fuel reactor, these variables include; for the reactor, degree of subdivision of fuel, relative coolant volume in reactor, coolant inlet and mixed mean outlet temperatures; for the boiler, temperature drives in heat exchangers; and for the turbo-generator plant, steam pressure and temperature, amount of regenerative heating, and condenser pressure. Assuming that the optimum temperature drives in the heat exchangers and the optimum condenser pressures are known, a method of analysis is presented by which curves showing the relationship of the remaining variables in terms of parameters translatable into power cost are obtained. These curves can then be used in determining the set of conditions for minimum power cost. As examples, the method of analysis is applied to liquid metal cooled reactors. A comparison is made between a split flow, single stream cycle cooling system; a single flow, split steam cycle cooling system; and the conventional, single flow, single steam cycle cooling system. The effects of different maximum fuel temperatures, different mean temperatures in the heat exchangers, and the degree of regenerative heating on the variables affecting power cost are investigated. (auth)

## BIOLOGY AND MEDICINE

3

Argonne National Lab.

**QUARTERLY REPORT OF BIOLOGICAL AND MEDICAL RESEARCH DIVISION.** Oct. 1954. 100p. Contract W-31-eng-38. (ANL-5332)

Progress is reported from studies of the cytological effects of continuous irradiation of tumors by implants of  $\text{Sr}^{90}$  beads; the geographic distribution of bone tumors; the comparative biological effects of 80- and 250-kv x rays on the mouse; low-energy x-ray dosimetry determinations for rabbits; pyrophosphatase and adenosinetriphosphatase activity of rat spleen and thymus after irradiation; the radiosensitivity of renal function in young chicks; factors affecting the life span of experimental mice; the comparative effects of fast neutrons and  $\text{Co}^{60}$   $\gamma$  radiation on cataract formation in mice; the influence of the hypophysis and of the adrenal cortex upon the tissue mast cell count in rats; a study of photoperiodic stimulus in *Xanthuum*; tracer studies of the translocation of photosynthetic products in the phloem of grape; electron microscopic studies of the cells of the malpighian tubules of the grasshopper; design of an improved electron microscope specimen grid; the microstructure of collagen and the effects of Ca and of pathologic conditions on collagen structure in rat tails and Achilles tendon of guinea pigs; tracer studies of protein synthesis in frog oocyte and effects of x radiation on the syntheses of the egg yolks; the effects of Ge and Al on plant growth; the separation of flavonoid from tobacco leaves by two-dimensional paper chromatography; the effects of phosphates on metabolism in dog erythrocytes; auxin biosyntheses in plants; the localization of the tryptophan-indoleacetic acid enzyme system in bean leaves; tracer studies of the accumulation of phosphate by algae; mitochondrial structure in *Paramecium* and frog oocytes; protection of mice against radiation injury by heterologous serum and plasma proteins; the effect of injected Zr on the distribution of  $\text{Pu}^{239}$  at different time intervals after injection in rats; the therapeutic effectiveness of aurointricarboxylic acid in young and old Be-poisoned mice; design of an automatic counter for microorganisms; the absorption and utilization of isotopic N by buckwheat; and tracer studies of the biosynthesis of inulin. (For preceding period see ANL-5288.) (C.H.)

4

[Texas Univ.]

**A STUDY OF DISCRIMINATION LEARNING IN MONKEYS WITH IMPLICATIONS FOR THE INVESTIGATION OF THE PSYCHOBIOLOGICAL EFFECTS OF IONIZING RADIATION** (Project No. 21-3501-0003, Report No. 6.). J. M. Warren, [Univ. of Texas] and Sylvan J. Kaplan, School of Aviation Medicine, July 1954. 7p. Contract AF 18(600)-165. (NP-5371)

The effect of stimulus variables on discrimination learning in monkeys was investigated. It was found that the difficulty of discrimination problems is an inverse function of the number of relevant stimulus cues present. These results suggest the possibility and utility of a monkey intelligence test to aid in the analysis of the effects of radiation of the psychobiological efficiency of the organism. (auth)



5

Columbia Univ.

PROGRESS REPORT FOR JUNE 15, 1951-MARCH 14, 1952. Theodosius Dobzhansky. 16p. Contract AT-(30-1)-1151. (NYO-4005)

This report summarizes studies on the genetics of natural populations of several species of *Drosophila* flies. These populations are found to contain numerous genetic variants, similar in kind to these which are induced in living organisms by ionizing radiations. Many of these variants are in the nature of hereditary diseases; others, on the contrary, permit the natural populations to adapt themselves to the changing environments in their habitats. (auth)

6

Atomic Energy Project, Univ. of Calif., Los Angeles  
A KINETIC ANALYSIS OF THE GLYCOLYTIC RATE AND ITS RELATIONSHIP TO CELL ALDOLASE, ISOMERASE, GLYCERALDEHYDE-3-PHOSPHATE DEHYDROGENASE, LACTIC DEHYDROGENASE,  $\alpha$ -GLYCEROPHOSPHATE DEHYDROGENASE, AND PYRIDINE NUCLEOTIDES IN NORMAL AND LEUKEMIC LEUKOCYTES. William S. Beck. Nov. 4, 1954. 32p. Contract AT-04-1-GEN-12. (UCLA-314)

7

AIR POLLUTION. A BIBLIOGRAPHY. S. J. Davenport and G. G. Morgis (Bureau of Mines, Washington, D. C.). U. S. Bur. Mines Bull. 537, 1954. 448p. \$1.75.

This bibliography contains abstracts of 3902 references on air pollution. Topics covered include the nature and origin of air pollution, composition of air pollutants, effects of air pollution, methods of determining air pollution, control of air pollution, legal aspects of air pollution, and the cost of air pollution. (C.H.)

8

AN EXPERIMENTAL METHOD OF TISSUE SURFACE MEASUREMENTS OF BETA ACTIVITY IN VIVO. T. Baglioni, C. Garavaglia, A. Perussia, and C. Polvani (Istituto Nazionale dei Tumori, Milan). *Experimentia* 10, 438-9 (1954) Oct.

A technique is described which permits an accurate determination of the  $\beta$  radioactivity in the surface tissues of mice over a period of some hours. Brief comments are made on some time curves obtained in following  $P^{32}$  injected intraperitoneally, intravenously, and subcutaneously. (J.S.R.)

## RADIATION EFFECTS

9

Michigan State Coll.

THE ABSORPTION AND DISTRIBUTION OF RADIOACTIVITY IN PLANTS GROWN UPON SOILS CONTAMINATED WITH FISSION PRODUCTS—A PRELIMINARY REPORT. W. G. Long, F. G. Teubner, S. H. Wittwer, and H. B. Tukey. Sept. 1954. 15p. Contract AT(11-1)-159. (AECU-2945)

Corn, bean and radish plants were grown upon a soil contaminated with fission products. The plants exhibited injury symptoms, which resembled strontium toxicity, after 10 to 14 days' growth. Little visible growth occurred after the symptoms became severe. The radionuclides appear to be adsorbed rather strongly upon the soil organic matter fraction. The half life of the material was 24 to 25 days with slight variation between half lives of

plant and soil materials indicated some preferential absorption by the plants. The radioactivity probably results from a mixture of short and long half-lived elements including strontium and yttrium. (auth)

10

American Meat Inst. Foundation

UTILIZATION OF GROSS FISSION PRODUCTS. SUMMARY REPORT FOR PERIOD FEBRUARY 1, 1952-JUNE 30, 1954. 54p. Contract AT(11-1)-227. (AECU-2951)

Studies showed that fresh beef can be effectively sterilized by  $\gamma$  rays, but irradiation at these levels produced an unacceptable product, primarily attributable to the development of undesirable odors, flavors, and discolorations. While techniques were not studied to minimize the effect of free radicals in oxidative types of reactions induced by the ionizing radiations, the only procedure that consistently minimized the development of these undesirable attributes is irradiation of the meat in the frozen state. Considerable progress was made in quantitating certain of the chemical changes that occur in meat during irradiation. These changes, when meat is irradiated at a dosage level of  $1.5 \times 10^6$ , included the formation of odoriferous sulfur-containing compounds, a reduction in the total proteolytic enzyme activity, destruction or chemical modification of tyrosine, and conversion of the red pigment of meat, myoglobin, to a compound that absorbs light at 610 to 620 m $\mu$ . These aspects are discussed in detail. These studies provide a basis for further work on the relation of these changes, and the compounds produced, to the undesirable flavors, odors, and discolorations associated with irradiating meat with sterilization dosages. Studies with graded radiation levels (1,000 to 3 million rep) revealed that relatively low doses (60,000 to 70,000 rep) will kill the major meat spoilage microorganisms in fresh beef. These microorganisms, members of the genus *Pseudomonas*, are capable of growing at refrigeration temperatures. Environmental factors, such as the density of the population and the nature of the suspending medium, markedly affect the radiation sensitivity of this organism. It may be concluded from experimental tests that the shelf life of fresh beef with or without inoculation with these bacteria can be effectively extended when irradiated at low dosages and kept under refrigeration. It should be emphasized that these tests, in which the shelf life was extended up to five-fold, were carried out with meat kept in moist chambers. Other tests with meat kept in casings permeable to oxygen and moisture and stored in the meat drawer of a refrigerator, showed serious discoloration of the meat with or without these low irradiation treatments, presumably due in part to the drying out of the meat during storage. At these low levels of radiation (50,000 to 60,000 rep) no undesirable odors, flavors, or discolorations were detectable. (auth)

11

Washington Research Labs., National Canners Association, D. C.

INVESTIGATION OF GAMMA STERILIZATION. FINAL REPORT FOR THE PERIOD JULY 1, 1953 THROUGH JUNE 30, 1954. RESEARCH REPORT NO. 3-54. C. B. Denny, C. W. Bohrer, and J. M. Reed. Oct. 1954. 39p. Contract AT(30-1)-1567. (AECU-2952)

The effects of  $\gamma$ -radiation on bacterial species were



studied. Irradiation at 150°F is less destructive to spores of *Cl. botulinum* than irradiation at 72°F (room temperature), 23°F, or 0°F. Irradiation at 0°F appeared to be the most effective in destroying the spores of the test organism. The toxicity of oxygen during irradiation was again demonstrated at all temperatures studied. The rate of destruction of spores of *Cl. botulinum* during irradiation was more rapid in milk than in ground beef, squash, or peas. The rate of destruction in peas was less rapid than in any of the other foods tested. Apparently some factor or factors other than density exert a protective effect. Sugar concentrations of 2, 5, and 20% and salt concentrations of 0.5, 2, and 3% both alone and in combination had no appreciable effect on survival of spores of *Clostridium botulinum* at 4 levels of irradiation. A dose of 3.5 megaröntgens was demonstrated to be sufficient for the sterilization of representative low-acid and semi-acid foods inoculated with a mixture of *Cl. botulinum* strains. With the possible exception of meat, cans of food subjected to a dose of 3.5 megaröntgens at room temperature were less acceptable than frozen or heat processed foods when compared organoleptically. (auth)

12

Hanford Works

EFFECT OF BODY DISTRIBUTION AND RETENTION OF TRITIUM ON THE HAZARD OF EXPOSURE TO TRITIUM OXIDE. Roy C. Thompson. Jan. 1, 1954. 31p. Contract W-31-109-Eng-52. (HW-30340)

Data from a variety of experiments are interpreted in relation to the increased hazard occasioned by non-uniform distribution of tritium oxide and long-term retention of organically-bound tritium in the body. It is concluded that nonuniform distribution of body water may increase radiation dosage rates to certain tissues by as much as 25 per cent over that which would be calculated on the assumption of uniform distribution. Tissue binding of tritium will not appreciably affect dose rates immediately following exposure but may increase the total absorbed dose by an average of 10 per cent for the total body and perhaps by as much as 100 per cent for certain specific locations within the organism. These conclusions are derived largely from rat experiments. (auth)

13

Air Force Radiation Lab., Univ. of Chicago  
BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING RADIATION. THE EFFECT OF X-IRRADIATION ON THE ACTION OF ANALGESIC DRUGS. (School of Aviation Medicine, Project No. 21-3501-0005, Report No. 14) John C. Ballin and James L. Wilding. Air Force Radiation Lab. and Dept. of Pharmacology, Univ. of Chicago. Apr. 1954. 5p. Contract AF33(038)27353. (NP-5329)

The influence of whole-body x irradiation on the pharmacological response to analgesic drugs was studied, as well as the effect of these agents on radiation toxicity. The results of this study have shown that whole-body x irradiation in doses of 250, 500, and 750 r exerted no effect on the sensitivity of rats to painful thermal stimuli nor did these doses of x-ray affect the analgesic response of rats to morphine sulfate, codeine phosphate, meperidine hydrochloride, and methadone hydrochloride. The response of rats to standard doses of these agents at ½, 1, and 2 hours after injection was not altered by the prior administration of 500 r of whole-body x irradiation. Large doses of codeine phosphate, meperidine hydrochloride, and

methadone hydrochloride did not influence the ultimate lethality of whole-body x irradiation in mice. (auth)

14

Air Force Radiation Lab., Univ. of Chicago  
BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING RADIATION. THE ADENOSINE TRIPHOSPHATASE AND 5-NUCLEOTIDASE ACTIVITY OF HEMATOPOIETIC TISSUES OF IRRADIATED ANIMALS. (School of Aviation Medicine Project No. 21-3501-0005, Report No. 13). Kenneth P. DuBois and Donald F. Petersen. Air Force Radiation Lab. and Dept. of Pharmacology, Univ. of Chicago. [May 1954]. 8p. Contract AF-33(038)27353. (NP-5333)

Measurements of the adenosine triphosphatase and 5-nucleotidase activity of the spleens and thymus glands of rats and mice exposed to sublethal doses of x irradiation showed that these tissues exhibit an increased ability to hydrolyze adenosine triphosphate and 5-adenylic acid. This increase in enzyme activity was detectable as early as 3 hours after x ray and reached a maximum within 72 hours. The alteration in enzyme activity was reversible with the rate of reversal depending upon the dose of x ray. Within the dose range of 25 to 400 r the amount of increase in the adenosine triphosphatase activity of the spleens and thymus glands of rats was directly related to the dose of x ray administered. Doses in excess of 400 r did not evoke additional increases in the adenosine triphosphatase activity of the hematopoietic tissues. A similar relationship between dosage of x ray and nucleotidase activity was observed in the spleens and thymus glands of rats when doses of 100 r to 400 r were administered. Lethal doses of x ray caused an irreversible increase in the phosphatase activity of the spleens and thymus glands of rats and mice. (auth)

15

Naval Medical Research Inst., Bethesda  
THE METABOLISM OF INJECTED RADIOACTIVE GLUTATHIONE ( $S^{35}$ ) IN X-IRRADIATED AND NONIRRADIATED MICE. (MEMO REPORT 54-1). William H. Chapman and J. W. Duckworth. Mar. 22, 1954. 4p. (NP-5366)

A study of the metabolism of injected radioactive glutathione ( $S^{35}$ ) in x-irradiated and nonirradiated mice has been undertaken. The background and the experimental design and results to date are presented. (auth)

16

School of Aviation Medicine  
LOCUS OF EMETIC ACTION OF IRRADIATION. (Project No. 21-3501-0001, Report No. 3). Herman I. Chinn, School of Aviation Medicine and S. C. Wang, Columbia Univ. Coll. of Physicians and Surgeons. May 1954. 5p. (NP-5411)

The incidence of vomiting among dogs receiving from 300 to 800 r is reported. All dogs exposed to 800 r vomited within two hours after completion of the irradiation. The 50 percent vomiting dose was 540 r. No dog subjected to bilateral destruction of the emetic chemoreceptor zone vomited after 800 r exposure. The significance of these findings is discussed. (auth)

17

Atomic Energy Medical Research Project, Western Reserve Univ.  
WHOLE BODY RADIATION AS A CARCINOGENIC AGENT.



Simon Koletsky, Gordon E. Gustafson, Phyllis Goldston, and Vera Milanich. Sept. 1, 1954. 24p. Contract W-31-109-eng-78. (NYO-4964)

A series of rats which survived a single dose of 660 r of whole-body radiation showed an unusually high incidence of neoplasms. The animals developed a wide variety of tumors, both benign and malignant, especially in skin and subcutaneous tissue but also in viscera. Both the frequency of neoplasms and the number of tumors per rat increased with duration of life. Individual rats often showed multiple diverse types of neoplasms. Of the sixty-nine tumor-bearing animals, forty-three had one or more malignant neoplasms. There were fourteen rats with fibrosarcoma, eight with carcinoma of the skin, eight with carcinoma of the kidney, five with osteogenic sarcoma, and five with neuroblastoma. Such tumors are apparently quite uncommon or rare as spontaneous lesions, especially in the Wistar strain. This study demonstrates the carcinogenic potency of whole-body radiation. In addition to direct tissue injury, an indirect or systemic mechanism induced by radiation may have been operative in promoting carcinogenesis. (auth)

# 18

Atomic Energy Medical Research Project, Western Reserve Univ.

QUARTERLY PROGRESS REPORT, APRIL-JUNE 1954.

Hymer L. Friedell. 8p. Contract [W-31-109-eng-78]. (NYO-4968)

Data are reported from studies of the effects of x radiation on ascites tumor growth in mice, determinations of sulphydryl levels in rat tissues, the carcinogenic effects of radioactive colloidal Au on the liver, the mechanism of death in rats following massive whole-body irradiation, the therapeutic effects of injected bone marrow against radiation injuries, the separation of the acid-soluble components of normal and irradiated rat thymus, the effect of temperature on the incorporation of  $P^{32}$  by excised lymph node slices, and the differential uptake of  $P^{32}$  in the diagnosis of eye tumors. (For preceding period see NYO-4960.) (C.H.)

# 19

Atomic Energy Project, Univ. of Rochester

THE EFFECTS OF IRRADIATION WITH PHOSPHORUS-32 ON THE VIABILITY AND GROWTH OF RAT EMBRYOS.

M. R. Sikov and T. R. Noonan. Oct. 8, 1954. 27p. Contract W-7401-eng-49. (UR-327)

The effects of beta radiation on rat embryos of six, eight, nine, and ten days of gestational age have been studied by the intraperitoneal administration of  $P^{32}$  to pregnant females. Values for the LD-50 were found in terms of the doses of  $P^{32}$  which, when administered to the mother, would be expected to kill 50 percent of the fetuses by the fourteenth day of gestation. These values, which were found to be dependent on the day of gestation on which injection was made, were: day 6, 0.46 mc; day 8, 0.57 mc; day 9, 0.77 mc; and day 10, 1.29 mc. The uptake of the radiophosphorus was also studied at several doses. From these data, the radiation doses to the embryo were calculated for each day of gestation. By interpolation of the uptake data it was possible to estimate the radiation dose received by an embryo at the LD-50 level. For the first four days after injection these were: day 6, 300 rep; day 8, 450 rep; day 9, 560 rep; and day 10, 925 rep. It was also found that uptake was proportional to the injected dose, indicating no major interference with phosphorus metabolism. All doses of  $P^{32}$

produced a depression of the weight of the embryos as measured on the fourteenth day of gestation. The magnitude of the depression followed the same pattern as did the LD-50, earlier embryos being more sensitive. (auth)

# 20

LATE EFFECTS OF THERMAL NEUTRON IRRADIATION IN MICE. A. C. Upton, J. Furth, and K. W. Christenberry (Oak Ridge National Lab., Tenn.). Cancer Research 14, 682-90(1954) Oct.

Pathologic effects caused in mice by irradiation in the thermal column (thermal neutrons and gamma rays) were qualitatively indistinguishable from those of x radiation. The relative biological effectiveness of thermal neutron radiation was essentially the same for most late effects, such as induction of leukemia and other neoplasms and reduction of longevity, as for acute lethality and acute hematologic injury. The relative biological effectiveness of thermal neutrons was several times higher for cataract induction than for acute lethality. The RF mouse, like man, is susceptible to induction of myeloid leukemia by relatively low doses of ionizing radiation. (auth)

# 21

SOME LATE EFFECTS IN MICE OF IONIZING RADIATION FROM AN EXPERIMENTAL NUCLEAR DETONATION.

Jacob Furth, Arthur C. Upton, Kenneth W. Christenberry, Walter H. Benedict, and Jack Moshman (Oak Ridge National Lab., Tenn.). Radiology 63, 562-9(1954) Oct.

Data are summarized from an investigation of the late effects of ionizing radiations from a nuclear detonation on a large population of mice. The radiations were composed predominately of high-energy  $\gamma$  rays, with a small component of fast and a still smaller component of slow neutrons, the  $\gamma$ -neutron ratios increasing with the distance from ground zero. Data collected 30 months after the detonation are summarized. Topics discussed include mortality, cataracts, iris defects, graying, leukemia, ovarian tumors, pituitary tumors, harderian gland tumors, mammary gland tumors, other tumors, and nephrosclerosis. (C.H.)

# 22

THE EFFECT OF X-IRRADIATION ON THE GROWTH AND HISTOCHEMISTRY OF ADRENAL AUTOTRANSPLANTS IN THE RAT. Leland C. Wyman, Rae Whitney, Patricia L. Griffin, and Donald I. Patt (Boston Univ., Mass.). J. Cellular Comp. Physiol. 44, 33-47(1954) Aug.

The effects of direct x irradiation of the adrenal glands of rats or of local irradiation of the site of implantation, with 2000 r, on the subsequent growth of intramuscular, autoplasmic, adrenocortical transplants was studied. Site irradiation was more effective in preventing successful establishment of implants than was direct gland irradiation. But once the tissue was established, its ability to grow rapidly and to assume the histochemical characteristics of normally regenerating cells was affected more by direct irradiation than by irradiation of the site of implantation. Gland irradiation had a prolonged depressing effect on mitotic activity, while site irradiation had only a temporary effect. Values for lipids determined by sudanophilia and birefringence were equivocal, but failure to exhibit ascorbic acid was induced both by gland and by site irradiation. Analysis of the data showed that when the transplant was capable of exhibiting ascorbic acid the cells did so at about the same level of activity, regardless of their treatment. Total secretory capacity, however, was reduced more by



gland than by site irradiation, since it depends largely on the size of the transplant rather than on individual cell performance. (auth)

## 23

THE EFFECT OF IONIZING RADIATION ON DEOXYRIBONUCLEASE ACTIVITIES OF BODY FLUIDS. I. THE EFFECT OF TOTAL BODY EXPOSURE ON THE URINARY EXCRETION OF DEOXYRIBONUCLEASES. O. D.

Kowlessar, Kurt I. Altman, and Louis H. Hempelmann (Univ of Rochester School of Medicine and Dentistry, N. Y.) *Arch. Biochem. and Biophys.* 52, 362-72(1954) Oct.

Some of the properties of urinary DNases of the rat have been described. It has been shown that there is increased acid and neutral DNase activity in the urine of rats exposed to total-body x rays. (auth)

## 24

THE 'OXYGEN-EFFECT' IN IONIZING IRRADIATION.

H. Laser (Univ. of Cambridge, England). *Nature* 174, 753 (1954) Oct. 16.

Bacteria representing strict and facultative aerobes and anaerobes, as well as some yeasts, were exposed to 190-kv x rays to study whether the "oxygen effect" requires the maintenance of normal respiration during irradiation and whether it bears any relation to a particular type of cellular metabolism. None of the metabolic reactions measured was significantly affected by irradiation when measured in washed nongrowing cells, except aerobic fermentation of baker's yeast, which was slightly inhibited. All cells examined, however, when transferred into growth-promoting media showed an "oxygen effect". In the case of *Sarcina lutea* it was possible to abolish almost completely the "oxygen effect" at doses up to 26,000 r, if cell respiration was inhibited by respiratory poisons during the irradiation. (L.M.T.)

## 25

RELATIONSHIP BETWEEN BLOOD LIPIDS AND RADIATION INJURY IN RABBITS. Lawrence J. Milch, Richard A. Yarnell, James V. Stinson, John G. Collins, Lesly G. Robinson, Beulah L. Croye, and Sherman S. M. Chang (USAF School of Aviation Medicine, Randolph Field, Texas). *Science* 120, 713-14(1954) Oct. 29.

Groups of rabbits were subjected to varying doses of local x irradiation up to 30,000 r, and determinations were made of the plasma lipid and lipoprotein concentrations at each radiation level. Data indicate that the plasma lipid and lipoprotein components measured showed changes over the dose range corresponding to the increasing continuum of muscle injury. (C.H.)

## 26

BIOLOGICAL EFFECTS OF THE PERIODICALLY INTERRUPTED X RADIATION. André Dennier. *J. radiol. et électrol.* 35, No. 7-8, 578-81(1954). (In French).

The effects of periodically interrupted x radiation were compared with the effects of continuous radiation on grains and rabbits. Periodic x radiation has the same biological effects as a dose of continuous radiation twice as large. When the distance between the radiation source and the target is varied, there is a summation effect for periodic radiations between a distance of 5 and 10 cm. (J.S.R.)

## 27

EFFECT OF RADIATIONS ON VEGETABLE CELLS AND THEIR METABOLISM. E. De Bernardi and E. Macclotta. *J. radiol. et électrol.* 35, No. 7-8, 569-71(1954). (In French).

The effects of varying amounts of radiation on the growth and development of narcissi and onions were studied. The narcissi were placed in a solution of  $\text{KNO}_3$ ,  $\text{Ca}(\text{NO}_3)_2$ ,  $\text{Ca}_3(\text{PO}_4)_2$ ,  $\text{MgSO}_4$ , and  $\text{KCl}$ . The radiation was applied to the roots or the stems, or  $\text{U}(\text{NO}_3)_4$  was placed in the salt solution. The bulbs placed in the radioactive solution had the most robust development at the end of the experiment. The experiments with onions paralleled those with the narcissi. The plants receiving a medium dose of radiation developed best. Some preliminary measurements were made of the radiation effects on the salt uptake by the plants. (J.S.R.)

## 28

THE EFFECT OF CHRONIC GAMMA RADIATION ON ENDOSPERM MUTATIONS IN MAIZE. W. Ralph Singleton (Brookhaven National Lab., Upton, New York). *Genetics* 39, 587-603(1954) Sept.

Data are tabulated from studies of the effects of chronic  $\gamma$  radiation from a  $\text{Co}^{60}$  source on mutation rates in the male gametophyte in maize. (C.H.)

## 29

DOSE-RESPONSE RELATIONSHIPS IN RADIATION INDUCED MUTATION. SATURATION EFFECTS IN STREPTOMYCES. H. B. Newcombe and J. F. McGregor (Atomic Energy of Canada, Ltd., Chalk River, Ontario, Canada). *Genetics* 39, 619-27(1954) Sept.

In most organisms, x-ray-induced mutations increase linearly with dose while the corresponding ultraviolet-induced changes rise either to a plateau or to a peak followed by a decline. *Streptomyces* spores are exceptional in that the response to both agents is similar and varies nonlinearly with dose. A common cause is indicated, since combined treatment with ultraviolet and ionizing radiation has a less than additive effect. In the case of ultraviolet it has been shown that the long-lived (photoreversible) intermediate in the mutation process must increase linearly with increasing dose, but it is not certain whether the final nonlinear response is due to some subsequent step in the intracellular processes leading to mutation or to differential survival. It is suggested that the apparently linear x-ray response curves found with other organisms might be nonlinear at doses too high for convenient study and also that x rays, like ultraviolet, might perhaps act through the production of a long-lived intermediate. (auth)

## 30

A NONLINEAR RELATION BETWEEN X-RAY DOSE AND RECOVERED LETHAL MUTATIONS IN DROSOPHILA. H. J. Muller, I. H. Herskowitz, S. Abrahamson, and I. I. Oster (Indiana Univ., Bloomington). *Genetics* 39, 741-9 (1954) Sept.

When 1000 r of x rays were applied to adult males of *Drosophila melanogaster* which had hatched not more than 24 hours previously, and offspring derived from sperm ejaculated by these males 7 to 9.5 days after irradiation were tested, a frequency of  $6.5\% \pm 0.3\%$  of induced recessive lethals was found in the exposed X chromosomes. This frequency, being more than double that ordinarily obtained, confirms Lünig's finding that germ cells at the given period (i.e., that of 7 to 9.5 days prior to ejaculation, in newly hatched males) are especially susceptible to mutagenesis by ionizing radiation. However, a dose of 4000 r, under otherwise identical circumstances, resulted in only  $9.3\% \pm 0.6\%$  of induced recessive lethals. This marked flattening of the lethal frequency-dosage curve at high doses is interpreted as an effect of selection, operat-



ing more strongly at higher doses to kill off preferentially, by chromosome breakage, the descendants of the more susceptible germ cells, in which recessive lethals had been induced at a higher frequency. It is inferred that the germ cells of the period in question are heterogeneous in their susceptibilities and that there is a strong positive correlation between susceptibility to the chromosome breaking and that to the recessive lethal inducing effect of x rays. It is pointed out that heterogeneity of a similar kind probably exists, to a lesser extent, in the germ cells of a period shortly before ejaculation, when older males are used, and that it may even be present to some extent in the germ cells of that period in young males. In view of these considerations, and the fact that in most earlier work the importance of exactly controlling paternal age and germ-cell stage was not realized, the significance of earlier data purporting to show the continuing linearity of the lethal frequency-dosage relation at high doses becomes uncertain, and conclusions based on a supposed linearity in this dosage region should be held in abeyance until more definitive data can be obtained on material of maximal homogeneity. (auth)

### 31

EFFECT OF IRRADIATION ON THE SERUM PROTEIN IN RATS HAVING A BENZOPYRENE-INDUCED TUMOR. V. Verga and G. Giordano. *Boll. soc. ital. biol. sper.* 30, 614-15(1954) June. (In Italian).

### 32

RADIATION CANCER. REPORT OF 21 CASES. Olaf Petersen. *Acta Radiol.* 42, 221-36(1954) Sept.

After a review of the literature, 21 cases of radiation cancer of the skin are analyzed. Nineteen cases belong to the category of therapeutic radiation cancer, and 2 followed accidental radiation injuries in the early years of radiology. Four cases occurred after radium treatment, the remaining 17 after roentgen treatment. All changes appeared in areas of the skin which showed clinical signs of radiation changes, but any relationship between the severity of the radiation reactions and the latency period was not demonstrable. Treatment was in 15 cases purely surgical, and 2 cases were treated with x rays. A combination of roentgen therapy was used. Of the 21 cases, 14 have been followed for more than 5 years. Seven of these patients are alive without signs of recurrence, 3 have died from other diseases and without signs of growths, and 4 (28.6%) have died of cancer. (auth)

### 33

RESISTANCE OF BACTERIAL SPORES TO GAMMA RADIATION. Bruch H. Morgan and James M. Reed (National Canners Assoc. Research Labs., Washington, D. C.). *Food Research* 19, No. 4, 357-66(1954).

The results reported emphasize the importance in gamma-ray sterilization studies of thoroughly investigating the effect of conditions during spore production and spore irradiation. Under arbitrarily standardized conditions spores of *Cl. botulinum* were more resistant to gamma radiation than spores of the other food spoilage organisms investigated. However, it was shown that different conditions during spore production or irradiation can increase or decrease the sterilization requirement for a particular type of organism. In view of these results definition of a sterilizing gamma-radiation dosage with respect to spore-forming organisms should assume an environment affording maximum protection. (auth)

### 34

LABORATORY STUDIES FOR EVALUATING THE BIOLOGICAL EFFECTS OF PRIMARY COSMIC RADIATION. Ann C. Birge (Univ. of Calif., Berkeley). *J. Aviation Med.* 25, 326-30(1954) Aug.

The biological effects of primary cosmic radiation are discussed in reference to laboratory studies on the effects of ionizing radiations. Possible radiation hazards to aviators from this source are postulated. (C.H.)

## RADIATION HAZARDS AND PROTECTION

### 35

[Atomic Weapons Research Establishment, Aldermaston, Berks (England)]  
AGRICULTURAL AND BIOLOGICAL INVESTIGATIONS PERTAINING TO CONTAMINATION BY FISSION PRODUCTS. (MISCELLANEOUS PAPERS). July 16, 1954. 26p. (FWE-10)

Brief summaries are presented from studies of the uptake of fission products by both plants and animals following exposure in the environs of Operations Hurricane and Totem. (C.H.)

### 36

Knolls Atomic Power Lab.  
GRAPHIC AIDS TO ESTIMATE NUCLEAR RADIATION HAZARDS. J. J. Fitzgerald and D. G. Chappell. Aug. 30, 1954. 45p. Contract W-31-109-Eng-52. (KAPL-1178)

A quick and simplified method to estimate the hazard from a nuclear incident is presented. Nomograms and graphs are present to facilitate the determination of the hazard. (auth)

### 37

Atomic Energy Project, Univ. of Calif., Los Angeles  
EFFECT OF BEEF EMBRYO EXTRACT ON SURVIVAL TIME IN IRRADIATED MICE. Thomas J. Haley, W. G. McCormick, and Eve F. McCulloh. Oct. 19, 1954. 13p. Contract AT-04-1-GEN-12. (UCLA-311)

A study of the effects of various fractions of beef embryo extract on radiation mortality in mice indicates that injections of such materials on either days one and two or three and four give slight increases in the ST<sub>50</sub> day but have no effect on total mortality. Daily injections are not beneficial. These results appear to be related to the presence of a beneficial and a detrimental factor in the extracts. It was not possible to separate these factors from one another with the fractionation procedures used. (auth)

### 38

SPLEEN ADENOSINE TRIPHOSPHATASE ACTIVITY IN IRRADIATED MICE TREATED WITH SPLEEN HOMOGENATE. Willie W. Smith, William Anderson, Jr., and Gilbert Ashwell (National Institutes of Health, Bethesda, Md.). *Am. J. Physiol.* 178, 471-3(1954) Sept.

Changes in ATPase activity, spleen weight, and leucocyte count were studied in LA<sub>1</sub> mice treated with spleen homogenate after 650 r. Streptomycin was used to increase survival in the irradiated controls. The duration of spleen involution and high ATPase activity was much shorter, and subsequent hypertrophy and low ATPase activity were less marked in homogenate-treated than in irradiated control mice. There was little change in total spleen ATPase in homogenate-treated mice, while in irradiated controls this was below normal for three weeks and higher than normal in the fourth week. (auth)



## 39

EFFECT OF GRANULOCYTE COUNT AND LITTER ON SURVIVAL OF IRRADIATED MICE. Willie W. Smith, Leon Gonschery, Ilo Alderman, and Jerome Cornfield (National Institutes of Health, Bethesda, Md.). Am. J. Physiol. 178, 474-6(1954) Sept.

Survival of mid-lethally irradiated mice was associated with the granulocyte count taken either 4 or 7 days after irradiation. There was no association between lymphocyte count and survival. The clustering of survival in litters was highly significant in contrast to the clustering of relatively high granulocyte counts. The occurrence of *Pseudomonas*, *Proteus*,  $\alpha$ -streptococcus, and negative cultures, but not *E. coli*, in postmortem blood was significantly influenced by litter. (auth)

## 40

THE INITIAL MEDICAL AND INDUSTRIAL USE OF RADIOACTIVE MATERIALS (1915-1940). William B. Looney (U. S. Naval Hospital, Bethesda, Mo.). Am. J. Roentgenol. Radium Therapy Nuclear Med. 72, 838-48(1954) Nov.

Thousands of persons were given radioactive materials in clinical medicine twenty to thirty years ago. Radium chloride was given orally and intravenously in the treatment of hypertension, arthritis, gout neuritis, gout, etc., from about 1915 to 1930. Thorium dioxide was used in diagnostic radiology from about 1930 to 1945. Hundreds of persons ingested or inhaled significant amounts of radium, mesothorium, and radiothorium in the luminous dial painting industry from about 1917 to 1925 before adequate protective measures were taken. Recent studies (1952) on luminous dial workers and patients given radium therapeutically have revealed that fifteen to thirty-five years may elapse before symptoms, skeletal change, or tumor formation occur. Small skeletal changes have been found in patients given thorotrast fifteen to twenty years ago (1952). These persons constitute the major source of clinical material for determining the amounts of a radioelement that can be retained safely by the body for protracted periods of time. The importance of locating these individuals and referring them to a laboratory equipped to determine the residual radioactivity is stressed. (auth)

## 41

A PROTECTIVE EFFECT OF INORGANIC MAGNESIUM AGAINST ROENTGEN RADIATION DAMAGE TO HYDRA. George E. Daniel and Helen D. Park (Public Health Service, Bethesda, Md.). Am. J. Roentgenol. Radium Therapy Nuclear Med. 72, 857-66(1954) Nov.

Magnesium in appropriate amounts has a marked effect in alleviating and preventing the damage caused in Hydra by 15,000 r of x rays. The advantages of magnesium are apparent only when the material is used postirradiation. There is no effect of preirradiation treatment and no synergistic action between pre- and postirradiation use of magnesium. Magnesium is the only ion of those studies (Fe, Mn, Be, Ba, Ca, K, and Mg) showing any protective effect. Mg/Ca ratio may be varied over a wide range without destroying the beneficial effects of the magnesium. Suggestions are presented relative to the physiological implications of the observed symptoms and the biological mechanism responsible for their appearance. (auth)

## 42

ON SEVERAL TECHNIQUES USED FOR THE PROTECTION OF PERSONNEL SUBJECT IRRADIATION OF  $\alpha$  AND  $\gamma$  RADIATION AND BY SLOW AND FAST NEUTRONS. M.

P. Savel (Coll. de France, Paris). J. phys. radium 15, 113A-18A(1954) Oct. (In French)

A method is described for using radiographic films for the protection of personnel subject to  $\gamma$  irradiation. The use of a scintillation counter for detecting  $\alpha$  contamination together with slow and fast neutrons provides a rapid indication for the protection of workers. (tr-auth)

## 43

INFLUENCE OF POTENTIAL ANESTHESIA ON THE MORTALITY RATE OF IRRADIATED GUINEA PIGS. Charles M. Gros and Jean Comsa. Compt. rend. 239, 832-4(1954) Oct. 4. (In French)

The results of previous investigations have shown that a correlation exists between the increased radiation resistance of mice exposed to x radiation and a reduction of the metabolic rate induced by refrigeration. An attempt is made to duplicate the reduced metabolic rate in guinea pigs by the injection of chemicals, and to examine the degree of radiation protection afforded by such a treatment. Very satisfactory radiation protection was found with the injection of 3-chloro-10-(3'-dimethylamino-propyl) phenothiazine and the ethyl ester chlorohydrate of 1-methyl-4-phenyl-4-piperidinecarboxylic acid. Maximum resistance to radiation injury was obtained when the animals were irradiated 10 hr after injection. Beneficial effects disappeared after 24 hr. (K.S.)

## 44

SUGGESTED PROCEDURE FOR PERFORMANCE OF AUTOPSIES ON RADIOACTIVE CADAVERS. Russell F. Cowing and Egilda DeAmicis (New England Deaconess Hospital, Boston, Mass.). New Engl. J. Med. 251, 380-2 (1954) Sept.

Precautions to be observed while performing an autopsy on a radioactive cadaver are outlined. (C.H.)

## RADIOTHERAPY

## 45

COMPARISON OF THE TRACER DOSE AND THE THERAPEUTIC DOSE OF  $I^{131}$  AS TO THYROID UPTAKE, EFFECTIVE HALF-LIFE, AND ROENTGEN DOSAGE. Lindon Seed and Bertha Jaffe (Augustana Hospital, Chicago, Ill.; Nelson M. Percy Research Foundation; and Oak Park Hospital, Oak Park, Ill.). Radiology 63, 551-61(1954) Oct.

A comparison was made with respect to the uptake and effective half life of the tracer dose and the first therapeutic dose of  $I^{131}$  in 91 patients with hyperthyroidism. The thyroid uptake and the effective half life of the therapeutic dose can be predicted with reasonable accuracy. An analysis was made of the clinical result as related to the dosage, in equivalent roentgens, in 67 patients with toxic diffuse goiter. The correlation of dosage and result seemed no better than that obtained by simply calculating the dosage on the basis of the thyroid uptake of the tracer dose and the estimated weight of the gland. (auth)

## 46

THE DISTRIBUTION OF RADIOIODINE OBSERVED IN THYROID DISEASE BY MEANS OF GEIGER COUNTERS—ITS DETERMINATION AND SIGNIFICANCE. J. P. Nicholson, C. W. Wilson, and K. A. Newton (Westminster Hospital, London, England). Am. J. Roentgenol. Radium Therapy Nuclear Med. 72, 849-56(1954) Nov.

A method is described to relate geometrically the observed count-rate distributions in thyroid tissue, fol-



lowing administration of tracer doses of  $I^{131}$ , to the actual anatomical site containing the activity. Closely fitting plaster casts of the anatomical region concerned were prepared, on the outer surface of which a rectangular coordinate system was drawn. Isocount-rate curves were determined from count-rate measurements made over a wide range of points in the coordinate system while the cast was on the patient. The procedure is illustrated by findings in several cases. (C.H.)

## TOXICOLOGY STUDIES

47

Hazleton Labs.

CHLORINE TRIFLUORIDE. John J. Horn. Aug. 1954. 40p. Contract DA-18-108-CML-4399. (MLCR-37)

The method of generating the vapor, the analytical method for determination of concentration, the signs of toxicity, hematology, urine analysis, biochemistry, mortality, and gross and microscopic pathology resulting from chronic inhalation of the vapors of chlorine trifluoride are described. (auth)

## TRACER APPLICATIONS

48

Radiation Lab., Univ. of Calif., Berkeley

INTERMEDIATES OF PHOTOSYNTHESIS: ISOLATION AND DEGRADATION METHODS. A. A. Benson and M. Calvin. Aug. 1954. 36p. Contract W-7405-eng-48. (UCRL-2682)

A pattern is presented for the photosynthetic incorporation of  $CO_2$ , and data obtained from tracer studies are presented on the distribution of C in photosynthetic intermediates. Isolation and degradation methods are presented for the separation and identification of  $C^{14}$ -labeled photosynthetic products. (C.H.)

49

USE OF  $P^{32}$  AS AN AID IN DIAGNOSIS OF INTRAOCULAR NEOPLASMS. I. J. Eisenberg, I. S. Terner, and I. H. Leopold (Wills Eye Hospital, Philadelphia, Penna.). Arch. Ophthalmol. (Chicago) 52, 741-50(1954) Nov.

Conclusions based on findings in 123 cases are presented on the usefulness and limitations of the differential uptake of  $P^{32}$  as an aid in the diagnosis of intraocular neoplasms. (C.H.)

## CHEMISTRY

50

Institute for the Study of Rate Processes, Univ. of Utah  
THE QUANTITATIVE APPLICATION OF INFRARED SPECTROSCOPY TO STUDIES IN SURFACE CHEMISTRY. Robert O. French, Milton E. Wadsworth, Melvin A. Cook, and Ivan B. Cutler. Feb. 1954. 28p. Contract AT(49-1)-633, Technical Report No. 3. (AECU-2938)

Results are reported from fundamental studies concerning flocculation, employing infrared spectroscopy, in investigations of the surfaces of solids. A modified vacuum die is described which was constructed to rapidly and reproducibly prepare solid samples for spectrographic study. Both KBr and KI were investigated as mounting materials, and KI was chosen because of the shorter pressing time required to produce plates. A systematic

shift in clay OH groups was demonstrated for Wyoming bentonite taken from solutions of various pH, and the presence of an organic flocculant on bentonite was also detected. This technique was applied to flotation studies in which oleic acid was adsorbed on fluorite ( $CaF_2$ ). The carboxyl salt and undissociated carboxyl were clearly evident. This is attributed to the presence of physically adsorbed undissociated oleic acid which may also chemisorb at elevated temperatures to form at the surface the Ca oleate carboxyl salt. The absence of the cis and trans absorption suggests cross polymerization of the adsorbed oleic acid. The adsorption of ammonia on silica gel and silica-alumina cracking catalysts was also detected by this technique. Ammonia adsorbed as  $NH_4^+$  was evident, but ammonia present as chemisorbed  $NH_3$  was obscured by the OH bending absorption. A linear relationship between the weight gain during adsorption and log percent transmission for the  $NH_4^+$  bending frequency is shown. (C.H.)

51

Oklahoma Univ.

THE ATOMIC PARACHOR, REFRACTION AND DISPERSION OF BORON IN ORGANO-BORON COMPOUNDS. P. L. Pickard and M. K. Patterson, Jr. Sept. 29, 1954. 21p. [For Callery Chemical Co., Contract NOa(s)-52-1024-C]. (CCC-1024-TR-45)

Techniques and apparatus for determining the surface tension, density, and index of refraction of organo-boron compounds in an atmosphere of  $CO_2$  are described. The atomic parachor, refraction, and dispersion of boron were determined in trialkoxyboranes and found to range from 0.261 to 0.450, 1.407 to 3.987, and 18.52 to 20.52, respectively, and in the trialkylboranes 0.375 to 0.802, 0.50 to 1.57, and -9.09 to 12.10, respectively. Exchange between trialkoxyboranes and alcohols was attempted and was determined by the index of refraction of the mixtures. This method was found to be unsuitable in determining exchange in this case. Refluxing a mixture of benzyl alcohol and triethoxyborane (molar ratio 3:1) followed by distillation yield a high boiling fraction whose properties differed from those of the alcohol. (auth)

52

Lehigh Univ.

A STUDY OF THE ELECTROLYSIS OF BORON COMPOUNDS IN INORGANIC MELTS IN THE TEMPERATURE RANGE  $350^\circ C$  TO  $550^\circ C$ . W. W. Ewing and J. W. Marr. Oct. 26, 1954. 20p. [For Callery Chemical Co. Contract NOa(s)-52-1024-c]. (CCC-1024-TR-58)

A study of the electrolysis of molten, boron-containing, electrolytic melts in the temperature range 350 to  $550^\circ C$  is summarized. Systems were found which had suitable freezing points which served as solvents for boron compounds or which were mixtures of boron compounds. The two most suitable systems were  $KCl-LiCl-KBF_4$  and  $K_2B_4O_7-K_2B_2O_4-KBF_4$ . The cathode product consisted of a brownish black powder of small particle size. It analyzed from 40 to 78% boron depending upon the electrolysis variables such as nature of the bath, temperature, current density, and concentration. The remainder was oxygen. The best conditions seemed to be the cell: Cu, 50%,  $KCl-41\% LiCl-9\% KBF_4$ , C at two amperes per in.<sup>2</sup> cathode current density and high temperatures. A hypothetical cathode reaction is  $3M^+ + 3f \rightarrow 3M, 3M + KBF_4 \rightarrow B + KF + 3MF$ . The second reaction seemed to be slow since free alkali metal was found in the cathode deposit. (auth)



## 53

Pittsburgh Univ. Graduate School of Public Health  
**BORON ANALYSIS. PROGRESS REPORT for 1953-1954 AND SUMMARY of 1952-1954 STUDIES ON CHEMISTRY OF BORON HYDRIDES AND TOXICITY OF BORANES.**  
 William H. Hill and Joseph L. Svirbely. Sept. 1954. 120p. Contract DA-18-108-CML-3910. For Chemical Corps Medical Labs., Army Chemical Center. (MLCR-42)

Data are presented from studies of the toxicology, mechanisms of action, and methods of analysis for boron and boron compounds in animal tissues. Data are included from chronic toxicology studies employing rabbits, dogs, monkeys, mice, rats, and accidental human exposures. Methods are presented for the preparation of tissue samples for chemical analysis, and chemical, colorimetric, spectrographic, and ultraviolet methods are presented for the determination of boron, boric acid, and boron hydrides in animal tissues and urine. Attempts were unsuccessful to find a therapeutic agent for boron hydride poisoning. Silica gel and activated charcoal were found to be the most effective materials tested for the absorption of boron hydrides when used as gas mask fillers. (C.H.)

## 54

Mound Lab.  
**THE VAPOR PRESSURE OF ACTINIUM. (PRELIMINARY REPORT).** K. W. Foster. July 7, 1953. 9p. Contract AT-33-1-GEN-53. (MLM-901)

The vapor pressure of  $\text{Ac}^{227}$  at  $1,600^\circ\text{C}$  was determined by measuring the rate of evaporation of the material from a molybdenum crucible, and was found to be approximately 0.007 millimeter of mercury. From these data the boiling point was estimated to be approximately  $3,300^\circ\text{C}$ . These values are in approximate agreement with a number of other experiments involving the volatilization of actinium. The experimental technique is described, and some problems are discussed. (auth)

## 55

Technical Information Div., Library of Congress  
**REPORTS ON BORON COMPOUNDS. (ABSTRACT BULLETIN U4).** Oct. 25, 1954. 17p. (NP-5023)

## 56

Georgia Inst. of Tech. State Engineering Experiment Station

**RESEARCH ON SURFACE PROPERTIES OF FINE PARTICLES. QUARTERLY REPORT NO. 3.** J. M. Dallavalle, Clyde Orr, Jr., and H. G. Blocker. Jan. 30, 1952. 32p. Contract DA-36-039-sc-5411. (NP-5376)

Two variations of the usual low-temperature, gas adsorption technique of surface area measurement were studied. A number of experimental results relative to the first method, the continuous-flow method, are presented and discussed. The second method, the rate of adsorption method, is described in detail, and a few experimental results are given. (For preceding period see AT-139487.) (J.S.R.)

## 57

Research Inst., Temple Univ.  
**HIGH TEMPERATURE PROJECT. FINAL REPORT.** Joseph B. Conway, Aristid V. Grosse, and W. L. Doyle. July 1, 1954. 63p. Contract N9-onr-87301. (NP-5408)

The combustion of Zr powder in  $\text{O}_2$  was studied. The thermodynamic properties of the components were considered to obtain a theoretical value for the flame temperature at atmospheric pressures. A theoretical value of

$3980^\circ\text{K}$  was obtained which agreed well with experimental results. The procedures and equipment are described in detail. The cyanogen- $\text{O}_2$  flame at high pressures was studied. Experimental and theoretical results agreed. (J.S.R.)

## 58

New York Univ.  
**PHASE RELATIONS IN THE SYSTEM SODIUM OXIDE-URANIUM TRIOXIDE-WATER AT  $50^\circ$  AND  $75^\circ\text{C}$ .** [FINAL REPORT]. John E. Ricci and Frank J. Loprest. [Aug. 1954]. 51p. Contract AT(30-1)-1256. (NYO-3525)

Equilibrium phase relations in the system sodium oxide-uranium trioxide-water at  $50^\circ$  and  $75^\circ\text{C}$  were investigated by phase rule methods. In addition to the terminal solids of  $\text{NaOH}\cdot\text{H}_2\text{O}$  and  $\text{UO}_3\cdot 2\text{H}_2\text{O}$ , there are at  $50^\circ$  four intervening solid combinations of the two oxides, all incongruently soluble, the concentration of uranium trioxide in the liquids throughout being of the order of 10 to 20 mg/l. For solutions almost saturated with sodium hydroxide, containing from 42.8 to 45.2%  $\text{Na}_2\text{O}$  (the solubility of  $\text{NaOH}\cdot\text{H}_2\text{O}$ ), the saturating solid is a pink hydrated compound with a high ratio of sodium oxide, probably 5 or 6  $\text{Na}_2\text{O}$  per  $\text{UO}_3$ . The next solid phase for liquid concentrations extending down to 0.0106%  $\text{Na}_2\text{O}$  is a solid solution of considerable range in composition and ranging in color from bright orange to plain yellow. If it is anhydrous its upper sodium oxide limit is at  $\sim 8\text{Na}_2\text{O}\cdot 11\text{UO}_3$ , while if it is slightly hydrated it may just include the formula  $\text{Na}_2\text{UO}_4\cdot\text{H}_2\text{O}$ ; its lower limit is very nearly  $\text{Na}_2\text{O}\cdot 3\text{UO}_3$ . The familiar diuranate formula,  $\text{Na}_2\text{U}_2\text{O}_7$ , is therefore simply a point in the continuous range of this principal solid solution. This phase is followed, for liquid concentrations down to 0.00058%  $\text{Na}_2\text{O}$ , by the compound  $\text{Na}_2\text{O}\cdot 6\text{UO}_3$  which shows little, if any, tendency to take up adjacent solids in solid solution. There follows finally another solid solution ranging approximately from  $\text{Na}_2\text{O}\cdot 12\text{UO}_3$  to  $\text{Na}_2\text{O}\cdot 18\text{UO}_3$ , and saturation with both this solid and  $\text{UO}_3\cdot 2\text{H}_2\text{O}$  occurs at 0.00012%  $\text{Na}_2\text{O}$  in the liquid. The  $75^\circ$  isotherm was studied only for liquid concentrations below 30%  $\text{Na}_2\text{O}$ , showing in this region the same sequence, nature, and compositions of solid phases as at  $50^\circ$ . The  $\text{Na}_2\text{O}$  concentrations of the three isothermally invariant liquids covered, each saturated with two solids, are lower than at  $50^\circ$ . (auth)

## 59

Radiation Lab., Univ. of Calif., Berkeley  
**A METHOD FOR PREPARING CODEINONE.** Henry Rapoport and Helen N. Reist. Aug. 27, 1954. 5p. Contract W-7405-eng-48. (UCRL-2683)

A new and superior method has been found for preparing codeinone by silver carbonate oxidation of codeine. (auth)

## 60

Radiation Lab., Univ. of Calif., Berkeley  
**THE CHEMISTRY AND THERMODYNAMICS OF VANADIUM(V).** (thesis). Mary Joan LaSalle. Sept. 22, 1954. 32p. Contract W-7405-eng-48. (UCRL-2694)

The thermodynamic functions for the pervanadyl ion in perchloric acid solution were determined at  $25^\circ$  and compared to those for other ions of the  $\text{MO}_4^{+}$  type and their anionic counterparts. The free energy of solution was determined by extrapolation of the equilibrium solubility product constant to zero ionic strength, and the heat of solution was obtained by solution calorimetric methods. Thermodynamic functions were also calculated for the vanadyl ion by using the above and other supplementary values. The absorption



spectra and calculated extinction coefficients are presented for the pervanadyl and vanadyl ions, and the x-ray-diffraction pattern for the hydrate  $V_2O_5 \cdot H_2O$  which was identified is also reported. (auth)

## 61

Radiation Lab., Univ. of Calif., Berkely  
CHEMISTRY DIVISION QUARTERLY REPORT [FOR]  
JUNE, JULY, AUGUST 1954. Sept. 30, 1954. 47p.  
Contract W-7405-eng-48. (UCRL-2709)

Rats, separated by the behavioral test of hypothesis preference in an insoluble maze, show decided differences in cholinesterase activity of the visual, somesthetic, and motor cortical areas. A comparative investigation of the metabolism of adenine-4,6- $C^{14}$ , adenine-8- $C^{14}$ , and adenine-2- $C^{14}$  was initiated, and preliminary data are given. A 75% yield of codeinone may be obtained by heating under reflux a solution of codeine in benzene with 500 mole % of  $Ag_2CO_3$ .  $CO_2$  fixation by *Rhodospseudomonas capsulatus* is much faster in light than in the dark. In light the  $CO_2$  is assimilated through the phosphoglyceric cycle, and in the dark through the Krebs cycle. A method is given for the synthesis of 4,6-dithiol hexanoic acid and its oxidation product bisnor-thioctic acid. To determine if the acetate dosage (2mg) in acetate metabolism of pantothenic acid-deficient rats is a critical factor, a series of respiratory metabolic experiments were conducted in which 5 $\mu$ C Na acetate-2- $C^{14}$  in varying amounts of total acetate (0.2 to 100 mg) were used. There is no significant difference in the total excretion of  $C^{14}O_2$  from 0.2 to 20 mg of acetate, but the recovery of  $C^{14}$  from 100 mg of acetate is markedly depressed. The effects of  $Co^{60}$  irradiation (a total body dose of 1300 rep) on the respiratory metabolism of glucose, glycine, and DL-leucine in mice was studied. There is a consistent indication that amino acid utilization in the irradiated animal may be decreased, more for glycine than for DL-leucine. A careful determination of the relative intensities of the 1-Mev and 100-kev peaks in  $Np^{238}$  decay showed the unconverted  $\gamma$  and K x-rays of the 100-kev region have a total intensity of about 4% of the total number of unconverted  $\gamma$  transitions in the 1-Mev region. The  $\gamma$  irradiation of isopropyl ether gives more methane and less ethane than H-ion or electron irradiation. Accompanying the electron capture activity of  $Zr^{88}$  a single  $\gamma$  ray of  $395 \pm 5$  kev energy was detected.  $\gamma$ - $\gamma$  coincidence studies indicated presence of  $Y^{88m}$  with a half life for the transition  $Y^{88m} \xrightarrow{395 \text{ kev}} Y^{88}$  of  $0.34 \pm 0.05$  msec. The half life of  $Np^{240}$  was determined as  $63 \pm 1$  min. The nuclear quadrupole resonances of Cu in CuO was measured as 26.01 and 26.72 for  $Cu^{63}$  and 24.07 and 24.73 Mo for  $Cu^{65}$  at 299 and 77°K, respectively. The ratio of the quadrupole moments  $QCu^{63}/QCu^{65}$  was 1.0804 and 1.0806, respectively.  $Np^{239}$  has a spin of  $I = \frac{1}{2}$  (h/2 $\pi$ ). Direct thermal ionization of Ag gives an ion spectrum containing the  $Ag^+$ ,  $Ag_2^+$ ,  $Ag_3^+$ , and  $Ag_4^+$  in approximate abundances 15:7:30:1. (For preceding period see UCRL-2647.) (J.S.R.)

## 62

Atomic Energy Project, Univ. of Rochester  
A PRELIMINARY INVESTIGATION OF SOME RADIO-COLLOIDAL PROPERTIES OF POLONIUM<sup>210</sup> USING MOLECULAR FILTERS. P. E. Morrow, R. J. Della Rosa, L. J. Casarett, and G. J. Miller. Oct. 19, 1954. 32p.  
Contract W-7401-eng-49. (UR-363)

A limited investigation of polonium in some solutions commonly used in biological studies was undertaken with

molecular filters. By filtration, some of the effects of the hydrogen ion concentration, ionic strength, aging, impurities, and polonium concentration on polonium colloid were examined. The adsorption of polonium to glass was studied, and the preparation of two soluble polonium complexes was accomplished. By autoradiography, the polonium colloid was characterized and related to the filterability of polonium. The inferences of some of the results with respect to biological studies are discussed. (auth)

## 63

SOME COMMENTS ON THE EFFECT OF THE DEGREE OF DISPERSION AND DENSITY OF PHASES UPON EQUILIBRIUM. V. A. Kireev [Kireyev]. Translated from *Izvest. Sektora Fiz.-Khim. Anal., Inst. Obschei Meorg. Khim., Akad. Nauk S.S.S.R.* 19, 134-43 (1949). 13p. (AEC-tr-1967)

It has been established that differences in the degree of dispersion or compactness of phases can occasion quite considerable differences in the values of the isobaric, isothermal potential (the free energy) of a substance. An increase in the degree of dispersion or a decrease in density and, more especially, a transition from crystalline to vitreous structure causes a rise in this potential, amounting to several thousands of calories per mole in many cases. This corresponds to a change in the equilibrium constant, the solubility, or the pressure of the saturated vapor by a factor of ten, hundreds, thousands, millions, and even more in the direction of an increase in the activity of the substance and a reinforcing of its tendency to separate out of the given phase, in phase transition processes as well as in chemical reactions. The influence of these factors may greatly exceed the influence of a difference in crystalline modifications and must be borne in mind when determining the various thermodynamic constants. Failure to allow for these effects is one of the principal sources of discrepancy between the results cited by different authors for the values of entropy and enthalpy of formation and of many other thermodynamic characteristics. It is the action of these very factors that bring about all the phenomena of supersaturation during the separation of new phases in space (supersaturation of vapor or of a liquid, superheated or supercooled liquids, the phenomenon of prefusion, and the like), the aging of precipitates and their loss of activity with time or as the result of calcining, and many other phenomena. It has been established that the supercooling of liquids, in particular, is due to the much lower melting point of extremely small crystals. It has also been established that neglecting the entropy component and assuming that the isobaric surface potential (the free energy) is the same as the total surface energy, as done in some researches, is incorrect as a rule. (auth)

## 64

THE DEHYDRATION OF MAGNESIUM CHLORIDE WITH LIQUID AMMONIA. A. M. Monoszon, E. N. Guryanova, and A. I. Shatenshtein. Translated from *Zhur. Khim. Prom.* 12, 279-81(1935). 7p. (AEC-tr-1968)

The dehydration of  $MgCl_2$  with liquid  $NH_3$  by the Blitz method (British patents 327,481 and 327,482) is discussed. Laboratory-scale tests showed complete dehydration with negligible hydrolysis of the salt, lack of apparatus corrosion, and freedom from wastage, since the  $NH_3$  used for the dehydration was regenerated or used as a raw material for conversion to other materials. (J.A.G.)



## 65

EFFECT OF THE FREE ENERGY OF THE PROCESS OF PREPARING PYROLYTIC NICKELOUS OXIDE ON ACTIVATED ADSORPTION. (Vliianie svobodnoi energii protsessa prigotovleniia piroliticheskoi zakisi nikelia na aktivirovannuiu adsorbtsiiu). S. Z. Roginski and T. F. Tsellinskaya [Tsellinskaia]. Translated by G. Belkov from *Zhur. Fiz. Khim.* 21, 919-26(1947). 14p. (TT-471)

The data given show that there is a large sensitivity in the activity of nickelous oxide in the process of activated adsorption of the gases studied ( $\text{CO}$ ,  $\text{O}_2$ , and  $\text{H}_2$ ) to supersaturation of the genetic reaction. In accordance with theory, activity increases rapidly with supersaturation, and simultaneously the initial activation energy falls, i.e., the increase in supersaturation creates a new, more active center on a nonuniform surface. The second interesting peculiarity of these data is the large similarity between the adsorption of gases described in this work for nickelous oxide and their adsorption on manganese dioxide according to older data. Apparently the mechanisms established for manganese dioxide are typical for active oxides, and similar results can be expected for a number of other systems, e.g., for chrome oxide, oxides of cobalt, iron, and others. (auth)

## 66

AMMONIUM NITRATE EXPLOSIVES. (Ammonsalpeter-Explosionen). A. Haid and H. Koenen. Translated by D. A. Sinclair from *Chem.-Ztg.* 76, 471-5(1952). 11p. (TT-481)

## 67

CHLORINE ISOTOPE EFFECT IN REACTIONS OF TERT-BUTYL CHLORIDE. Rosalie M. Bartholomew, F. Brown, and M. Lounsbury (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Can. J. Chem.* 32, 979-83(1954) Oct.

When tert-butyl chloride reacts with either alcoholic silver nitrate or aqueous alcoholic sodium hydroxide the  $\text{Cl}^{35}$  compound reacts faster than the  $\text{Cl}^{37}$  compound. The ratio of the rates of reaction is  $1.008^{+0.002}_{-0.001}$ . (auth)

## 68

ION EXCHANGE. Jack Schubert (Argonne National Lab., Lemont, Ill.). *Ann. Rev. Phys. Chem.* 5, 413-48(1954).

Recent developments in the theoretical and experimental approaches to ion exchange are reviewed. 237 references. (J.S.R.)

## 69

TABLES OF STATISTICAL ELECTRON DISTRIBUTIONS FOR ATOMS WITH DEGREE OF IONIZATION ZERO TO FOUR AND OF THE CORRESPONDING ELECTROSTATIC POTENTIALS. L. H. Thomas (Columbia Univ., New York). *J. Chem. Phys.* 22, 1758-67(1954) Oct.

The potential and electron density in statistical distributions for atoms according to Dirac's equation and Jensen's boundary conditions are given as functions of radial distance on a logarithmic scale for neutral atoms and for singly charged positive ions, at uniform interval of a parameter  $\gamma$ . A simple interpolation only is required to obtain them for any particular atomic number. The values of the separate terms in the energy of the distribution are also given. (auth)

## 70

ON THE REACTIONS IN SOLUTION BETWEEN ZIRCONIUM NITRATE AND THE ALKALI METAL IODATES. II. ON THE COMPOSITION OF THE PRECIPITATE OF ZIRCONIUM IODATE SETTLING FROM THE SOLUTION CONTAINING POTASSIUM IODATE. M. I. Konarev and A.

S. Solovkin. *Zhur. Obshchei Khim.* 24(86), 1279-83(1954) Aug. (In Russian).

The composition of freshly precipitated  $\text{Zr}(\text{IO}_3)_4$  was not established. After prolonged standing in the mother solution the precipitate reacts with  $\text{KIO}_3$  and iodic acid to form the hexaiodate and nonaiodate, and it is converted from the amorphous to the crystalline form. The nonaiodate is formed at high concentration of iodate ions. A mixture of the two iodates is more often found, however than the single species of either. (J.S.R.)

## 71

ELECTROKINETICS OF HYDROGEN EVOLUTION. IV. ISOTOPIC SEPARATION AT MERCURY CATHODES.

Martin Rome and C. F. Hiskey (Polytechnic Inst. of Brooklyn, N. Y.). *J. Am. Chem. Soc.* 76, 5207-11(1954) Oct. 20.

Techniques have been developed and a cell designed for the determination of the electrolytic separation factor at a mercury cathode by means of a mass spectrometer. The separation factor has been determined over a range of temperatures from 0 to 96.5° and of current densities from  $10^{-4}$  to  $3 \times 10^{-2}$  amp/cm<sup>2</sup>. Impurity effects of stopcock grease have been evaluated. The dual theory of Horiuti and Okamoto for the mechanism of electrode separation is applied for the case of a mercury cathode. (auth)

## 72

ZIRCONIUM (AND HAFNIUM) TETRACHLORIDE-DIETHYL PHTHALATE. R. V. Moore and S. Y. Tyree (Univ. of North Carolina, Chapel Hill). *J. Am. Chem. Soc.* 76, 5253-5(1954) Oct. 20.

The preparation and chemical and thermodynamic properties of the  $\text{ZrCl}_4$  and  $\text{HfCl}_4$  addition compounds of diethyl phthalate are described. (J.S.R.)

## 73

DEUTERIUM ISOTOPE EFFECT IN THE REACTION OF WATER VAPOR WITH ZINC. Warren G. Henderson, Jr. and Richard B. Bernstein (Illinois Inst. of Tech., Chicago). *J. Am. Chem. Soc.* 76, 5344-6(1954) Nov. 5.

The deuterium isotope effect in the reaction of water vapor with zinc was measured over the range 295 to 415°. The fractionation factor, defined as the ratio of the specific rates of reaction of HOH and HOD with zinc, was found to be  $1.6 \pm 0.1$  at 400°. The temperature dependence of the fractionation factor over the above range was  $-0.0011$  (°C)<sup>-1</sup>. The magnitude of the isotope effect observed is somewhat smaller than the theoretical upper limit given by Eyring and Cagle for the case of the rupture of an isolated oxygen-hydrogen bond. From the present results it has been possible to evaluate the correction required for incomplete conversion of water to hydrogen in the usual analytical procedure for deuterium. (auth)

## ANALYTICAL PROCEDURES

## 74

Atomic Energy Research Establishment, Harwell, Berks (England)

THE DETERMINATION OF GALLIUM. G. W. C. Milner. Aug. 10, 1954. 3p. (AERE-C/M-213)

A method for the volumetric determination of Ga is reported. The method consists of the addition of glacial acetic acid followed by  $\text{NH}_4\text{OH}$  dropwise to adjust the pH to a value of 2.8 and the addition of an indicator. The solution is then titrated against a standardized (ethylene-diamine)tetraacetic acid solution. (J.A.G.)



## 75

Jet Propulsion Lab., Calif. Inst. of Tech.

CONDUCTOMETRIC METHOD FOR THE RAPID CHEMICAL ANALYSIS OF THE NITRIC ACID-NITROGEN DIOXIDE-WATER SYSTEM. David M. Mason, Lois L. Taylor, and Stephen P. Vango. Jan. 4, 1954. 25p. Contract DA-04-495-Ord-18. (JPL-PR-20-205; AD-25846)

A method employing the measurement of the specific electrolytic conductance of a pair of duplicate samples of fuming nitric acid permits a rapid, fairly accurate chemical analysis for  $\text{HNO}_3$ ,  $\text{NO}_2$ , and  $\text{H}_2\text{O}$  without requiring gravimetric or volumetric measurements. At a given temperature the conductance of a sample of fuming nitric acid, together with the conductance of a duplicate sample saturated with anhydrous  $\text{KNO}_3$ , gives sufficient information to determine the composition of the sample. Other conductometric procedures, which used a pair of measurements and employed drying agents to remove  $\text{H}_2\text{O}$  or a stream of air to remove  $\text{NO}_2$  from the samples, proved to be impractical. Values of the specific conductance of saturated solutions of  $\text{KNO}_3$  in fuming nitric acid in the composition range 0 to 16 wt.%  $\text{NO}_2$  and 0 to 10 wt.%  $\text{H}_2\text{O}$  were obtained at  $0^\circ\text{C}$ . Data necessary for utilizing this conductometric method of analysis in the composition range 0 to 15 wt.%  $\text{NO}_2$  and 0 to 10 wt.%  $\text{H}_2\text{O}$  are presented in graphical and tabular form, and the procedure adopted is described. Although for convenience the ice point was chosen as a reference temperature in this investigation, the analytical method described could in principle be used at other temperatures near ambient. By this method  $\text{NO}_2$  can be determined on an absolute basis to  $\pm 0.3$  wt.% and  $\text{H}_2\text{O}$  to  $\pm 0.3$  wt.% in the composition range studied. The underlying principles of this method, together with the chemistry of nitric acid solutions, are discussed. (auth)

## 76

Mound Lab.

ASSAY OF POLONIUM-208-209 MIXTURES BY OPTICAL SPECTRA. D. J. Hunt and G. Plish. Aug. 8, 1952. Decl. Oct. 14, 1954. 25p. Contract AT-33-1-GEN-53. (MLM-735)

Isotopic ratios of polonium in artificially produced samples were determined with spectrographic methods and electrodeless discharge tubes. These ratios of  $\text{Po}^{208}$  to  $\text{Po}^{209}$  were determined from intensity ratios of the band-heads due to the two molecules,  $(\text{Po}^{208})_2$  and  $(\text{Po}^{208}\text{Po}^{209})$ . A probable error of  $\pm 7$  per cent was calculated. Standard deviation calculations indicated that 95 per cent of the averages lie within 17 per cent of the grand average. Since no standard samples were available with which to compare the data, the accuracy of analysis was indicated as  $\pm 20$  per cent (auth)

## 77

National Bureau of Standards

SURVEY OF METHODS FOR THE DETERMINATION OF OXYGEN IN OXYGEN-ENRICHED AIR. John A. Fitzmaurice. Jan. 15, 1954. 121p. Contract AF(33-616)52-5. (NBS-3130)

## 78

Geological Survey

THE DETERMINATION OF POTASSIUM AND SODIUM IN SILICEOUS, ARGILLACEOUS, AND PHOSPHATIC ROCKS BY THE FLAME PHOTOMETER. Lillie Jenkins. July 1954. 17p. (TEI-453)

A routine method is given for the determination of

potassium and sodium in siliceous, argillaceous, and phosphatic rocks using the Beckman flame photometer 10300. The sample is dissolved with  $\text{HF}_2$ ,  $\text{HNO}_3$ , and  $\text{HClO}_4$ , evaporated to fumes of perchloric, made up to volume, and the solution atomized. No separations are involved. Potassium has a pronounced enhancing effect on the flame intensity of sodium, but a series of correction curves is used to compensate for this effect. None of the other elements studied caused any serious interference. The results obtained by this procedure are within  $\pm 3$  percent of the amount of each alkali present in the sample. (auth)

## 79

Division of Production, AEC

AN ECONOMIC APPROACH TO SAMPLE SIZE. Miller N. Hudson. Oct. 1954. 14p. (WASH-183)

Procedures available for estimating sample size are outlined. A technique for allocating effort which permits explicit consideration of certain economic factors is developed, and an example given of its use. Certain derivations are outlined for selected formulas. (auth)

## 80

MICRODETERMINATION OF SULFUR IN ORGANIC SUBSTANCES. M. Věčera. Translated from *Chem. Listy* 48, 613-16(1954). 5p. Available from Associated Technical Services (Trans. 19F4C), East Orange, N. J. (AEC-tr-1970)

## 81

RAPID DETERMINATION OF THORIUM IN ORES. 2. ESTIMATION OF TRACE AMOUNTS OF THORIUM IN COMPLEX MINERALS AND ORES. Mahadeo M. Tiliu and V. T. Athavale (Atomic Energy Commission, Bombay, India). *Anal. Chim. Acta* 11, 324-8(1954) Oct.

A very rapid method for the estimation of trace amounts of thorium up to 0.01% even in complex minerals like ilmenite and columbite-tantalite has been described. Thorium is collected in an acid solution with phosphates of zirconium and titanium without prior separation of silica, after decomposition of the mineral with sodium peroxide. Thorium is next collected as fluoride with lanthanum as a carrier, precipitated as thorium iodate in potassium iodate-oxalic acid mixture, and finally titrated against 0.01 N sodium thiosulphate. Accurate results are obtained within a short time of two working days. (auth)

## 82

ESTIMATION OF METALS AS SULPHIDES. 2. ESTIMATION OF PLATINUM METALS. I. K. Taimni and G. B. S. Salaria (Univ. of Allahabad, India). *Anal. Chim. Acta* 11, 329-38(1954) Oct.

It has been shown that all the platinum metals with the exception of osmium can be estimated as sulfide if the solution containing the metal is treated with a large excess of alkali sulfide followed by excess of acetic acid and ammonium acetate. The precipitate of the sulfide can be washed with water, alcohol and ether successively, dried in a vacuum desiccator, and weighed. By the above procedure it is possible to complete the analysis for all the platinum metals within 3 hours, whereas the procedures described in the literature require much longer time—in many cases more than 24 hours. The precipitates obtained by the older procedures were very sticky and difficult to filter. By carrying out the precipitation in the presence of acetic acid and ammonium acetate it has been possible to obtain the precipitate in an easily filterable form. The above method not only provides a very con-



venient general method of estimating the platinum metals but also throws interesting light on the formation of thioisalts and the precipitation of sulfides by their decomposition. (auth)

63

THE OXINATES OF THORIUM AND SOME CERITE EARTHS. N. Eswaranarayana and Bh. S. V. Raghava Rao (Andhra Univ., Waltair, S. India) *Anal. Chim. Acta* 11, 339-49(1954) Oct.

The pH of precipitation of oxinates of thorium, cerium, and lanthanum has been studied. By controlling the pH of precipitation, thorium has been separated as the oxinate. From a spectrochemical study of the 4 and 5 oxinates of thorium in dilute hydrochloric acid, acetone, carbon-tetrachloride, chloroform, and toluene, it has been suggested that the 5 complex is a definite compound, but not an addition body of the 4 compound. A colorimetric estimation of thorium has been suggested by measuring absorption at 320 m $\mu$  in hydrochloric acid and 330 m $\mu$  in acetone. Two ppm of the oxide has thus been estimated. (auth)

64

COLORIMETRIC DETERMINATION OF IRON IN TITANIUM ALLOYS. George Norwitz and Maurice Codell (Pitman-Dunn Labs., Frankford Arsenal, Philadelphia). *Anal. Chim. Acta* 11, 350-8(1954) Oct.

There is need for an improved method for the determination of iron in titanium alloys. In this paper a colorimetric method using o-phenanthroline is proposed. The method is applicable to the range of 0.02 to 9% iron. Two modifications of a basic procedure are described. One modification, applicable to ordinary titanium alloys, is a direct method. A second modification, applicable to alloys containing large amounts of certain alloying elements, calls for a prior separation of the iron by an ether extraction. In a direct method a one-gram sample is dissolved in hydrochloric acid and an aliquot of the solution taken. Hydroxylamine and ammonium tartrate are added, the pH of the solution is adjusted by the addition of sodium acetate, and o-phenanthroline added. A study was made to find the best pH and optimum amount of o-phenanthroline for the development of the color. (auth)

65

A NEW PHOTOMETRIC DETERMINATION FOR NICKEL WITH ETHYLENEDIAMINETETRACETIC ACID. Walter Nielsch and Gerhard Böltz (Versuchsanstalt der Fürstlich Hohenzollernschen Hüttenverwaltung, Laucherthal, Hohenzollern, Germany). *Anal. Chim. Acta* 11, 367-75 (1954) Oct. (In German)

It is possible to determine very high concentrations of nickel photometrically by means of (ethylenediamine) tetraacetic acid by working at a pH between 4.55 and 6.82. The absorption curves obtained for this complex are very reproducible; for these measurements an Elko II apparatus with filter S<sub>5</sub>E is used. High concentrations of ammoniacal salts hinder the measurement. The formation of the complex is not influenced by the anion of the compound of nickel used. The Lambert-Beer law is followed for strengths of nickel of 40 to 5000 mg/100 ml. This procedure is convenient for alloys rich in nickel. (auth)

66

APPLICATION OF ABSORPTION SPECTRUM OF SODIUM VANADATE TO DETERMINATION OF VANADIUM. Irwin M. Gottlieb, J. Fred Hazel, and Wallace M. McNabb

(Univ. of Penna., Philadelphia). *Anal. Chim. Acta* 11, 376-81(1954) Oct.

A method is proposed for the determination of small amounts of vanadium as found in certain ores, rocks and minerals. After fusion of the sample, the 8-hydroxyquinoline complex is extracted with chloroform and converted to sodium orthovanadate. The absorbancy of this compound is measured at a wavelength of 270 m $\mu$ . The present method does not depend on the formation of a colored complex and, hence, is independent of such conditions as time and temperature. (auth)

67

RAPID METHOD FOR THE SEPARATION AND DETERMINATION OF BISMUTH, ANTIMONY, AND TIN BY CONTROLLED CATHODE ELECTROANALYSIS. John A. Dean and Sam A. Reynolds (Univ. of Tennessee, Knoxville). *Anal. Chim. Acta* 11, 390-5(1954) Oct.

A study was made of the separation and determination of bismuth, antimony, and tin by electrochemical means, using controlled cathode potential. The effects of electrolyte composition, cathode potential, and temperature were investigated with respect to separations of the three metals and degree of recovery of each. Best results were obtained by use of an electrolyte containing sulfate and citrate. A procedure was devised which would serve for rapid analysis for bismuth, antimony and tin in the form of mixtures and alloys. (auth)

68

TURBIDIMETRIC MICRODETERMINATION OF ZIRCONIUM. Guy William Leonard, Jr., Douglas E. Sellers, and LeRoy E. Swim (Kansas State Coll., Manhattan). *Anal. Chem.* 26, 1621-3(1954) Oct.

As the reaction between zirconyl ion and phthalic acid gives a very finely divided precipitate which tends to stay in suspension, the possibility of using this reaction for a simple turbidimetric determination of zirconium was investigated. The zirconium phthalate suspension was found to be very stable and to follow Beer's law up to 125 ppm of zirconium. No critical control of the order of mixing, length of heating, period of cooling, or hydrogen ion concentration was necessary. The interference of the fluoride ion in a solution of known zirconium concentration can be used to estimate concentration of that ion. A simple, direct, and rapid turbidimetric method is described for the microdetermination of zirconium. This technique is useful for the determination of zirconium in the presence of high concentrations of various ions. (auth)

69

DETERMINATION OF TIN IN TITANIUM ALLOYS. William A. Dupraw (Armour Research Foundation, Chicago, Ill.). *Anal. Chem.* 26, 1642-5(1954) Oct.

A volumetric method for the direct determination of Sn in the range 0.50 to 3.00% in Ti alloys eliminates the acid-sulfide separation of Sn from Ti. The sample is dissolved in dilute fluoboric and sulfuric acids. The solution is oxidized with a slight excess of 30% hydrogen peroxide. Hydrochloric acid is added and the Sn reduced with Fe powder. Tin(II) is titrated with a standard 0.02N solution of potassium iodate. (auth)

70

ISOTOPIC EXCHANGES AND THE EXISTENCE OF TRICALCIUM PHOSPHATE IN BONE. J. Govaerts (Univ. of Liège, Belgium). *Nature* 174, 831-2(1954) Oct. 30.



Tricalcium phosphate (125-mg samples) was exposed in sealed pyrex tubes to 5 ml of radioactive disodium hydrogen phosphate or  $\text{CaCl}_2$  solutions at 18, 60, 120, and 180°C for increasing lengths of time. The extent of exchange was determined in the usual manner. For each temperature the exchanged fraction increased rapidly the first two hours, then a much slower increase followed. Analytical determinations indicated that the deposition of the  $\text{Ca}^{45}$  and  $\text{P}^{32}$  in the Ca phosphate was not accompanied by a proportionate net deposition of the non-radioactive Ca or phosphate. No linear relationship was apparent when the logarithms of the differences between percentages exchanged at any time and at "equilibrium" are plotted against time. The exchange curves do not obey a simple exponential law; it was possible to obtain curves analogous to radioactive decay curves. A lack of exchange was observed with tricalcium phosphate ignited at 900° and with large crystals of hydroxylapatite. (L.M.T.)

## CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

91

Buffalo Univ.

MECHANICAL STRENGTH, THERMAL EXPANSION AND STRUCTURE OF COKES AND CARBONS. S. Mrozowski. Apr. 15, 1954. 32p. Contract AT(30-1)-1440 (NYO-6103)

The correlation between frozen-in stresses, internal porosity, and thermal expansion in carbons is discussed. The micro- and macrostructure of cokes as revealed by x-ray techniques is discussed, and the complications introduced in the manufacturing process by mechanical failure in coke are considered. (auth)

92

THE CRYSTAL STRUCTURE OF  $\text{MnF}_2$ ,  $\text{FeF}_2$ ,  $\text{CoF}_2$ ,  $\text{NiF}_2$  AND  $\text{ZnF}_2$ . J. W. Stout and Stanley A. Reed (Univ. of Chicago, Ill.). J. Am. Chem. Soc. 76, 5279-81(1954) Nov. 5.

The crystal structures of the five anhydrous fluorides have been checked by x-ray diffraction, using samples prepared from the melt, and precise lattice constants have been determined. All five fluorides have the rutile structure  $\text{D}_{4h}^{14}$ -P4/mnm. The parameters, at 25°C, are:  $\text{MnF}_2$ ,  $a = 4.8734 \pm 0.0002$  Å,  $c = 3.3099 \pm 0.0005$  Å,  $u = 0.310 \pm 0.003$ ;  $\text{FeF}_2$ ,  $a = 4.6966 \pm 0.0002$  Å,  $c = 3.3091 \pm 0.0001$  Å,  $u = 0.305$ ;  $\text{CoF}_2$ ,  $a = 4.6951 \pm 0.0002$  Å,  $c = 3.1796 \pm 0.0003$  Å,  $u = 0.308 \pm 0.003$ ;  $\text{NiF}_2$ ,  $a = 4.6506 \pm 0.0002$  Å,  $c = 3.0836 \pm 0.0004$  Å,  $u = 0.310 \pm 0.003$ ;  $\text{ZnF}_2$ ,  $a = 4.7034 \pm 0.0002$  Å,  $c = 3.1335 \pm 0.0003$  Å,  $u = 0.307 \pm 0.003$ . (auth)

93

THE CRYSTAL STRUCTURE OF  $\text{Cs}_3\text{Fe}_2\text{Cl}_9$  AND OF  $\text{Cs}_3\text{Sb}_2\text{Cl}_9$ . Hideo Yamatera and Kazumi Nakatsu. (Inst. of Polytechnics, Osaka City Univ.). Bull. Chem. Soc. Japan 27, 244(1954) June.

## DEUTERIUM AND DEUTERIUM COMPOUNDS

94

THE DETERMINATION OF DEUTERIUM OXIDE BY INFRA-RED SPECTROMETRY. J. Gaunt (Atomic Energy Research Establishment, Harwell, Berks, England). Analyst 79, 580-5(1954) Sept.

A method is described for the analysis of heavy water at concentrations greater than 99.5 wt.%  $\text{D}_2\text{O}$ , based on the measurement of the absorption of HOD at  $3\mu$ . The accuracy is better than 1 part in 30,000 of the  $\text{D}_2\text{O}$  content. A method for the analysis of heavy water at concentrations

of 0 to 0.8% was developed. It was found possible to determine the heavy water content of water of twice natural enrichment with an accuracy of about 10 %. Both methods are rapid, requiring only 5 to 6 min for each determination. (auth)

## FLUORINE AND FLUORINE COMPOUNDS

55

SOLUBILITIES OF STANDARD SOLID SOLUTES IN FLUORO-CHEMICALS. Edward P. McLaughlin and Robert L. Scott (Univ. of California, Los Angeles). J. Am. Chem. Soc. 76, 5276-9(1954) Nov. 5.

The solubilities of three "standard" solutes, iodine, stannic iodide, and phenanthrene in a perfluoroamine,  $(\text{C}_4\text{F}_9)_3\text{N}$ , and a perfluoroether,  $\text{C}_8\text{F}_{16}\text{O}$ , were measured at 25, 35, and 45°. The very low solubilities of iodine and stannic iodide, determined by coulometric analysis, were found to fall within the framework of regular solution theory using a low solubility parameter, typical of most fluorochemicals, of 5.7 for both solvents. Phenanthrene solubility, determined spectrophotometrically, was found to be abnormally low. These results are compared with previous data on similar systems from which identical conclusions may be drawn. Only for mixtures of fluorochemicals with substances containing hydrocarbon groups does the regular solution solubility parameter treatment seem definitely inadequate; even there it accounts for the greater part of the nonideality. (auth)

## GRAPHITE

96

NUCLEATION AND GROWTH OF GRAPHITE IN STEEL. Floyd Brown (North Carolina State Coll., Raleigh). Welding J. (N. Y.) 33, 257s-61s(1954) June.

Measurements on the nucleation and growth of graphite in steel are reported in context with an abbreviated restatement of the problem of graphitization in steel. This phenomenon of subcritical graphitization of cementite has received much attention in the cast iron field, and since in spite of the difference in carbon and silicon levels the same principles are involved as in steel, some of the ideas developed in that field are drawn upon throughout. (auth)

## LABORATORIES AND EQUIPMENT

97

Atomic Energy Research Establishment, Harwell, Berks (England)

REMOTE CHEMICAL MANIPULATION ON A CENTILITRE SCALE. G. B. Cook, F. Morgan, and W. T. Spragg. Jan. 9, 1951. 6p. (AERE-C/M-103)

A system to remotely perform chemical operations on one to two curies of  $\beta$ - $\gamma$  activity is described. (L.T.W.)

98

Callery Chemical Co.

HAND-OPERATED PENTABORANE DETECTOR. L. J. Kuhns and R. H. Forsyth. Oct. 25, 1954. 6p. Contract [NOa(s)-52-1024-c]. (CCC-1024-TR-55)

A hand-operated monitoring device for measuring atmospheric pollution by boranes, employing a colorimetric reagent sensitive to these compounds and capable of detecting 0.5 ppm of pentaborane, is described. The instrument is about 20 times more sensitive to pentaborane than to diborane. (auth)



99

Naval Research Lab.

AN INSTRUMENT FOR THE RAPID AND CONTINUOUS DETERMINATION OF LOW CONCENTRATIONS OF WATER VAPOR IN GASES. Clarke C. Minter. Oct. 21, 1954. 17p. (NRL-4437)

A new thermal conductivity apparatus has been developed for the rapid and accurate determination of water vapor in air or other gases over a wide range of concentrations, even down as low as that corresponding to a dew point of  $-50^{\circ}\text{C}$ . In this equipment, several sources of error which in the past have restricted the use of thermal conductivity in hygrometry have been eliminated. The absolute pressure of water vapor in air or other gases can be obtained by comparing the thermal conductivity of moist gas with that of dry gas in a Wheatstone bridge, and then applying to the bridge output a correction for barometric pressure which is normally proportional to percent by volume of water vapor. The moist air mixtures used in calibrating the instrument were obtained either by saturating air at a given temperature between 1 and  $40^{\circ}\text{C}$  or by passing into the apparatus moist room air containing known concentrations of water vapor as determined by psychrometric methods. (auth)

100

REMOTELY CONTROLLED SURFACE EVAPORATOR FOR ROUTINE ANALYTICAL WORK. Elton H. Turk and Leon S. Markheim (Argonne National Lab., Lemont, Ill.). *Anal. Chem.* **26**, 1668-9(1954) Oct.

A remotely controlled surface evaporator for destroying nitrates in routine analytical work is described. One to four samples, in rack-mounted centrifugal tubes passed through coil heaters, may be processed at a time. The rate of evaporation of the solution may be as slow as 6 min/in. of travel. A 5-min. time-delay switch ensures complete dryness at the bottom of the tubes. The condensate on the upper portion of the tubes is removed by lowering the rack as a part of the cycle at the end of the 5-min. period. The size, power for the elevator, heater components, tube rack travel, and control devices are described. (J.A.G.)

101

IMPROVED TRIGGER CIRCUIT FOR AUTOMATIC TITRATIONS. W. N. Carson, Jr. (Hanford Works, Richland, Wash.). *Anal. Chem.* **26**, 1673-4(1954) Oct.

Modifications for a previously described trigger circuit for automatic coulometric titrations (*Anal. Chem.* **25**, 226(1953)) are presented. The dry cell in the comparison circuit was replaced by an electronic equivalent, which furnished a constant voltage to the comparison circuit slide wire stabilizing the setting of the trigger. The output relay was replaced with a delay output relay circuit, eliminating a tendency for an autotitrator to show oscillation or chatter at end points. In addition, the Leeds and Northrup Model A7664A-1 pH meter, which provides a recorder output suitable for the input to the trigger, replaced the modified Beckman Model H-2 pH meter. The number 356359-1 amplifier replaced the number 351921-1 amplifier. Necessary changes in the circuit to allow for these modifications are described. (J.A.G.)

RADIATION CHEMISTRY

102

Radiation Lab., Univ. of Calif., Berkeley

RADIATION DECOMPOSITION OF PURE ORGANIC

COMPOUNDS. Bert M. Tolbert and Richard M. Lemmon. Aug. 1954. 36p. Contract W-7405-eng-48. (UCRL-2704)

A review is presented on the changes produced in organic compounds by radiation. In general, the systems under consideration are restricted to water-free, air-free irradiations of single compounds. Data are reviewed regarding the types of compounds irradiated, the important G values, and the effects of functional groups on radiation sensitivity. (auth)

103

RADIATION CHEMISTRY. E. J. Hart (Argonne National Lab., Lemont, Ill.). *Ann. Rev. Phys. Chem.* **5**, 139-62 (1954).

New work and its significance to the general field of radiation chemistry in gases, liquids, and solids are reviewed. 138 references. (J.S.R.)

104

ELEMENTARY PROCESSES IN THE RADIATION CHEMISTRY OF WATER. Keith J. Laidler (Catholic Univ. of America, Washington, D. C.). *J. Chem. Phys.* **22**, 1740-5 (1954) Oct.

Schematic potential-energy diagrams are constructed for ground and excited states of  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{O}^+$ , and  $\text{H}_2\text{O}^-$ , making use of thermochemical, spectroscopic, and electron-impact data. On electron impact a gaseous water molecule is raised to various states of  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{O}^+$ , and  $\text{H}_2\text{O}^-$ , which may subsequently decompose to give  $\text{H}$ ,  $\text{O}$ ,  $\text{H}_2$ , and  $\text{OH}$  and the ions  $\text{H}^+$ ,  $\text{H}^-$ ,  $\text{O}^+$ ,  $\text{O}^-$ ,  $\text{OH}^+$ , and  $\text{H}_2^+$ . The exact mechanisms by which these atoms, radicals, and ions are produced are discussed in detail with reference to the potential-energy curves, due attention being paid to the appropriate correlation and selection rules. It is concluded that the production of  $\text{O}^-$  at 173 kcal electron energy probably proceeds via a  $^2\text{A}_1$ ,  $^2\text{B}_1$ ,  $^2\text{A}_2$ , or  $^2\text{B}_2$  state of  $\text{H}_2\text{O}^-$  which decomposes into  $2\text{H} + \text{O}^-$  without the prior formation of  $\text{OH}^-$ . The production of  $\text{O}^+$  at 437 kcal must necessarily proceed via a  $^4\text{A}_2$  or  $^4\text{B}_2$  state of  $\text{H}_2\text{O}^+$ , while  $\text{H}_2^+$  at 530 kcal must involve the formation of a  $^2\text{A}_2$  of  $^2\text{B}_2$  state; both these latter states are stable with respect to the simple breaking of an O-H bond. The nonappearance of  $\text{OH}^-$  in electron-impact experiments is shown to be related to the high stability of  $\text{OH}^-$ , states of  $\text{H}_2\text{O}^-$  which correlate with  $\text{H} + \text{OH}^-$  being of very high energy. The bearing of the treatment on the radiation chemistry of liquid water is briefly considered. (auth)

105

ELECTRON-INDUCED WATER DECOMPOSITION AND ITS RELATION TO MASS SPECTROMETRIC  $\text{C}_3^+$  MEASUREMENTS IN GRAPHITE VAPOR. Dwight A. Hutchison (Argonne National Lab., Lemont, Ill.). *J. Chem. Phys.* **22**, 1789-90(1954) Oct.

Preliminary results are presented on the chemical reaction in residual  $\text{H}_2\text{O}$ ,  $\text{O}_2$ , and  $\text{H}_2$  forming the dimer,  $(\text{H}_2\text{O})_2^+$ , induced by an electron beam of 50 v which ionized molecules in the mass spectrometer ion source. Data are compared with measurements on graphite vapor, having had their mass 36 ion peak previously ascribed to  $\text{C}_3^+$ . The normal isotopic  $\text{H}_2$  was employed, and the larger positive ion background peaks in the mass range 1 to 50 were studied. For comparison with the graphite measurements, data were taken at 20 v, and the linear increase of mass 36 with mass 18 was observed. (J.A.G.)



## RADIATION EFFECTS

## 106

Atomic Energy Project, Univ. of Calif., Los Angeles

THE EFFECT OF IONIZING RADIATIONS UPON ESSENTIAL METABOLITES IN AQUEOUS MEDIA. James F. Mead and Helen Lee Barrett. Oct. 29, 1954. 21p. Contract AT-04-1-GEN-12. (UCLA-313)

The literature on the effects of ionizing radiation on vitamins and essential fatty acids was reviewed. All of these substances are susceptible to some extent to destruction seems to follow a chain reaction as measured by changes in absorption spectra. A discussion of possible reaction mechanisms is included for some cases. (auth)

## 107

Radiation Lab., Univ. of Calif., Berkeley

A GUIDE TO SELECTION OF ORGANIC MATERIALS SUITABLE FOR RADIOCHEMICAL WORK. James F. Bennett. July 12, 1954. 18p. Contract W-7405-eng-48. (UCRL-2666)

Organic materials were tested at the Radiation Lab. to determine their suitability for radiochemical operations. The effects, if any, of irradiation, corrosive atmospheres, and temperature variables are listed. With these factors in mind, investigators may profitably use this information when deciding upon the best possible material for a given job. (auth)

## 108

CHEMICAL ACTION OF IONISING RADIATIONS IN AQUEOUS SOLUTIONS. PART XIII. ABSOLUTE YIELD OF THE FERROUS SULPHATE DOSIMETER. F. T. Farmer, T. Rigg, and J. Weiss (Univ. of Durham, Newcastle-on-Tyne, England). *J. Chem. Soc.* 3248-9(1954) Sept.

The authors report a new value  $16.2 \pm 0.8$  for  $G(\text{Fe}^{3+})$ , the moles of ferric salt produced per 100 ev, after correcting for photoelectric absorption when employing 200-kv x rays and using new established value of 35.0 ev instead of 32.5 ev for W, the energy required to produce an ion pair in air. (L.M.T.)

## RARE EARTHS AND RARE-EARTH COMPOUNDS

## 109

DIFFUSION COEFFICIENTS FOR AQUEOUS-SOLUTIONS OF CALCIUM CHLORIDE AND CESIUM CHLORIDE AT 25°. Philip A. Lyons and John F. Riley (Yale Univ., New Haven, Conn.). *J. Am. Chem. Soc.* 76, 5216-20(1954) Oct. 20.

Diffusion coefficients, molal refractive increments, and supplementary densities and relative viscosities are reported for calcium chloride solutions from  $c = 0.03$  to  $c = 6$ , and for cesium chloride solutions from  $c = 0.06$  to  $c = 6$ . In agreement with results available from the conductance method diffusion coefficients for cesium chloride approach the values predicted by the Onsager-Fuoss relation at low concentration. At higher concentrations the deviation from theory is positive. Data reported for calcium chloride solutions supplement existing data indicating a negative deviation from the Onsager-Fuoss theory, but the values presented are not consistent with the conductometric results which are at present available. Evidence is presented which suggests that Gouy diffusometry, as currently employed, yields data for very dilute electrolyte solutions which are inaccurate and define an upper bound to the correct values. (auth)

## 110

PRASEODYMIUM OXIDES. II. X-RAY AND DIFFERENTIAL THERMAL ANALYSES. E. Daniel Guth, J. R. Holden, N. C. Baenziger, and LeRoy Eyring (Iowa State Univ., Iowa City). *J. Am. Chem. Soc.* 76, 5239-42(1954) Oct. 20.

This is a study of oxides of praseodymium in the composition range  $\text{Pr}_2\text{O}_3$  to  $\text{Pr}_6\text{O}_{11}$ . X-ray powder diagrams of quenched samples were taken in order to investigate the structures of oxides of several compositions. High-temperature x-ray powder diagrams were taken for a check on the quenching procedure. Differential thermal analyses were made to further illustrate the stepwise nature of oxidation and reduction in this system. The results indicate that under equilibrium conditions oxides with hexagonal, body-centered cubic, rhombohedral or face-centered cubic lattices are stable at various compositions. As  $\text{Pr}_6\text{O}_{11}$  is reduced to  $\text{Pr}_2\text{O}_3$ , it undergoes changes in lattice from face-centered cubic to rhombohedral to body centered cubic to hexagonal. Each of these lattices is found to be stable over a range of compositions. The rhombohedral lattice has not previously been reported. (auth)

## 111

THE TERBIUM OXIDES. I. DISSOCIATION PRESSURE MEASUREMENTS: X-RAY AND DIFFERENTIAL THERMAL ANALYSES. E. Daniel Guth (Phillips Petroleum Co., Bartlesville, Okla.) and L. Eyring (Iowa State Univ., Iowa City). *J. Am. Chem. Soc.* 76, 5242-4(1954) Oct. 20.

Some oxides of terbium were investigated by dissociation pressure studies, differential thermal analyses, x-ray analyses on quenched samples, and high-temperature x-ray powder diagrams. It was found that the only oxides to show stability in the range  $\text{TbO}_{1.5}$  to  $\text{TbO}_{1.81}$  were  $\text{TbO}_{1.5}$ ,  $\text{TbO}_{1.71}$ , and  $\text{TbO}_{1.81}$ . The body-centered cubic lattice which was observed for  $\text{TbO}_{1.5}$  was found to take up oxygen to about  $\text{TbO}_{1.60}$ .  $\text{TbO}_{1.71}$  had a rhombohedral lattice, and  $\text{TbO}_{1.81}$  had the  $\text{CaF}_2$  type lattice. The changes in composition, from  $\text{TbO}_{1.60}$  to  $\text{TbO}_{1.71}$  and from  $\text{TbO}_{1.71}$  to  $\text{TbO}_{1.81}$ , could not be observed at equilibrium due to the extremely slow reaction rates. No evidence was found of a stable oxide  $\text{Tb}_4\text{O}_7$ . (auth)

## 112

OBSERVATIONS ON THE RARE EARTHS. LXIII. THE PREPARATION OF ANHYDROUS RARE EARTH METAL NITRATES. Therald Moeller and Victor D. Aftandilian (Univ. of Illinois, Urbana). *J. Am. Chem. Soc.* 76, 5249-50(1954) Oct. 20.

The anhydrous nitrates of La, Pr, Nd, Sm, Gd, and Y were prepared quantitatively by reacting the oxides with  $\text{NO}_2$  and heating the reacting system at  $150^\circ\text{C}$  for 24 hrs. If the system is heated at temperatures below  $140^\circ\text{C}$ , the nitrate yield is materially reduced. The nitrates are voluminous powders with colors comparable to those of the chlorides, which dissolve rapidly and completely by highly exothermic processes in water, ethanol, or anhydrous ethylenediamine to give clear solutions. (J.S.R.)

## 113

THE EFFECT OF AMINO-POLYACETIC ACIDS AND EXCHANGER FORM ON THE SEPARATION OF CERITE EARTHS. L. Holleck and L. Hartinger (Hochschule, Bamberg, Germany). *Angew. Chem.* 66, 586-9(1954) Oct. (In German)

An investigation is made of the dependence of the separa-



tion of cerite earths in exchanger columns on complex forming elution agents and on the type of exchanger cations. In the case of amino tetra-acetic acids the separation effect takes place in the sequence: (ethylenediamine) tetra-acetic acid, *o*-cyclohexane diaminotetra-acetic acid,  $\beta\beta'$ -diamino ethyl-tetra-acetic acid, and ethylene glycol-bis- $\beta$ -amino ethyl ether tetra-acetic acid. At a constant pH value this is due to the sinking complexity constant and its graduation in the series of rare earths, as well as to the pH dependence, which is different for the individual complex formers. The best separation effects were given by ethylene glycol-bis- $\beta$ -amino ethyl ether tetra-acetic acid at pH 6.75. The Nalcite HCR exchanger yields in the  $\text{NH}_4$  form, as compared with the H form, not only an immediate breach but also a considerable separation result. Differences in the effect at the Na, K, and  $\text{NH}_4$  form on one side and at the Ca form on the other side are explained. (auth)

#### 114

ON HETEROTYPE MIXED PHASES OF RARE EARTH OXIDES. II. THE OXIDE SYSTEM OF CERIUM AND PRASEODYMIUM. G. Brauer and H. Gradinger (Univ. of Freiberg i. Br., Germany). *Z. anorg. u. allgem. Chem.* 277, 89-95(1954). (In German).

The phase relations of Ce oxide between  $\text{CeO}_2$  and  $\text{Ce}_2\text{O}_3$  and of Pr oxide between  $\text{PrO}_2$  and  $\text{Pr}_2\text{O}_3$  were determined by x-ray investigation. Both oxide systems were shown to be completely consistent in the value of the three observed phases and similar with respect to the extent of these phases. The dioxide phase with a fluorite structure has practically no homogeneous range. The sesquioxide phase of a hexagonal A type can absorb a little additional  $\text{O}_2$ . In both these separate phases an intermediate oxide with a broad range and a lattice structure which changes continuously from the fluorite to the C-sesquioxide type exists in a region of medium oxidation. (tr-auth)

#### 115

OBSERVATION ON THE METHOD OF FRACTIONAL CRYSTALLIZATION OF DOUBLE MAGNESIUM NITRATES OF THE RARE EARTH ELEMENTS. G. Virts. *Zhur. Anal. Khim.* 9, 299-303(1954). (In Russian)

The effect of the method of crystallization on the efficiency of the fractionation of mixtures of cerite earths by double crystallization of the double Mg nitrate salts was determined. By means of radioactive Eu the separation of the cerite earths into the least soluble part (Nd, Pr, and La) and the most soluble (Sm and the following rare earths) was determined semi-quantitatively. Three methods of crystallization were studied: (1) spontaneous crystallization with slow cooling of the hot solution in air without stirring, (2) seeding of the hot solution and slow cooling in air without stirring, and (3) seeding of the hot solution and cooling by vigorous stirring. The third method gives the most effective fractionation. The second method appears better than the first. With slow cooling, fractionation by the third method appears more effective than with fast cooling. With crystallization of a very large part (more than  $\frac{2}{3}$  of the rare earths in the crystallized fraction) a decrease in fractionation occurs. The effectiveness of the crystallization is best when there is a smaller concentration of the Sm group in the mixture of rare earths. Fractional crystallization of the double Mg nitrate salts by the third method allows a rapid elimination of Sm group from a

rare earth mixture, comparatively poor in these elements. (tr-auth)

### SEPARATION PROCEDURES

#### 116

Polytechnic Inst. of Brooklyn

A GENERAL THERMODYNAMIC THEORY OF ION EXCHANGE PROCESSES. TECHNICAL REPORT ON ION EXCHANGE PROJECT. H. P. Gregor. Mar. 29, 1949. 40p. Contract N6-onr-263, T. O. 4. (NP-1959; U-10825)

This thermodynamic theory of exchange processes attempts to predict ion exchange phenomena, in particular distribution constants, from measurable physical quantities which are defined apart from the exchange processes themselves. A qualitative comparison between theory and experiment is presented for a limited number of cases; in general, agreement is good. The theory as presented applies particularly to systems where no interaction between fixed groups and movable ions takes place. As such, it applies in particular to strong acid cation exchange resins and non-reacting univalent cations. The theory also applies to anion exchange systems, where the same restrictions hold, such as strong base anion exchange resins or weak base resins in the presence of only strong acids. The fundamental exchange reaction may be utilized to determine swelling pressures in any system in which two species of particles having different molar volumes can be equilibrated. For example, swelling pressures within cellulose fibers could be evaluated, using this technique. (auth)

#### 117

Radiation Lab., Univ. of Calif., Berkeley

SUGAR PHOSPHATES, PAPER AND COLUMN CHROMATOGRAPHY. A. A. Benson. Aug. 1954. 32p. Contract W-7405-eng-48. (UCRL-2681)

The techniques and efficiency of paper chromatography and ion exchange for the separation and identification of sugar phosphates are reviewed. (J.S.R.)

#### 118

THE SELECTIVE BEHAVIOUR OF ION EXCHANGERS. H. Deuel, K. Hutschneker, and J. Solms. Translated from *Z. Elektrochem.* 57, 172-8(1953). 10p. (AERE-Trans-11/3/5/427)

Ion exchangers containing carboxyl groups were synthesized by the polymerization of acrylic acid or cross linking of pectinic acid with formaldehyde. The charge on the exchanger was varied by the preparation of materials esterified to different degrees. In this connection, the alkaline saponification of polygalacturonic acid methyl ester was investigated in detail. The selectivity of the ion exchanger is dependent on its density of charge. Furthermore, a great difference is shown in the selectivity of cross-linked polyacrylic and pectinic acids of equal exchanging capacity. Finally, the contact exchange between Amberlite IRO-50 and soluble polyelectrolytes (polyacrylic and pectinic acids), which were not cross linked, was investigated for various charge densities. It was shown that the charge density of the polyanion likewise affects the exchange of ions. Ion exchangers possess selective adsorbing capacities for ions. Thus the carboxyl-containing resins show, in contrast with those containing sulphonic acid groups, a striking selectivity for multivalent ions. The effect of the constitution and especially of the exchange capacity of resins on their selectivity for ions was studied. Cation exchangers which contain carboxylic groups—



acrylic acid polymers and resins obtained by cross linking of polysaccharides—are used. (auth)

## 119

THE CARRIER-FREE SEPARATION OF THE RADIOACTIVE ISOTOPES  $\text{Co}^{56}$ ,  $\text{Co}^{57}$ , AND  $\text{Co}^{58}$  FROM A MANGANESE TARGET. J. L. Dick and M. H. Kurbatov (Ohio State Univ., Columbus). *J. Am. Chem. Soc.* **76**, 5245(1954) Oct. 20.

The radioactive isotopes  $\text{Co}^{56}$ ,  $\text{Co}^{57}$ , and  $\text{Co}^{58}$  can be separated from a Mn target by complexing the Co with  $\alpha$ -nitroso- $\beta$ -naphthol. The complexing agent must remain in the sample solution for one hour to insure complete Co removal. 100% recovery of the Co isotopes was obtained in the range from pH 4 to 0.25N when an acetic acid solution of the reagent was used. When using saturated aqueous solution of  $\alpha$ -nitroso- $\beta$ -naphthol, the pH must be maintained between pH 4.7 and 6.2. (J.S.R.)

## 120

A NEW GLASS CELL FOR PREPARATIVE COUNTER-CURRENT DISTRIBUTION. M. Verzele and F. Alderweireldt (Univ. of Ghent, Belgium). *Nature* **174**, 702-3(1954) Oct. 9.

Design and operation of a new glass cell for preparative countercurrent distribution are reported. The technique uses separate cells and allows repeated additions of the mixture to be separated, in which the lower phase may be transferred in a direction opposite to the displacement of the upper phase. Manipulations of the cell for upper-phase and lower-phase transfers are described. (J.A.G.)

## 121

ADSORPTION AND EXCHANGE IN METAL-METAL ION SYSTEMS. Cecil V. King (New York Univ., New York City). *Ann. N. Y. Acad. Sci.* **58**, 910-24(1954) Sept. 15

A review is presented of the following topics in connection with present studies on adsorption in metal-metal ion exchange: (1) measurement of adsorption by classical methods; (2) exchange at metal surfaces; (3) and measurement of adsorption and area with tracers. (L.M.T.)

## SPECTROSCOPY

### 122

A RAPID SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF BERYLLIUM IN AIR DUST. Frank P. Landis and Mary C. Coons (General Electric Co., Schenectady, N. Y.). *Appl. Spectroscopy* **8**, 71-5(1954) May.

A method has been developed for the determination of Be in air dust samples at the rate of 11 min minutes per sample. The method involves the use of a small filter paper sample which is inserted into a cupped graphite electrode and arced in a conventional direct current arc. Certain treatments are necessary to ensure optimum excitation of the sample, including the addition of a  $\text{BaCl}_2$  carrier and internal standard. The method is sensitive to 0.002  $\mu\text{g}$  of Be on the filter paper, and the range of analysis extends to 0.1  $\mu\text{g}$ . The accuracy of the method is about  $\pm 30\%$  of the amount of Be present. (auth)

## SYNTHESES

### 123

Radiation Lab., Univ. of Calif., Berkeley  
ETHYL THIOLTRIFLUOROACETATE AS AN ACETYLATED AGENT WITH PARTICULAR REFERENCE TO

PEPTIDE SYNTHESIS. Elmer E. Schallenberg and M. Calvin. June 1954. 20p. Contract W-7405-eng-48. (UCRL-2632)

The use of ethyl thioltrifluoroacetate as an acetylating agent for amino acids and peptides is reported. This thiol ester acetylates the amino acid anion in good yield, giving crystalline products which are easily purified. The applicability to peptide synthesis was demonstrated by the preparation of N-trifluoroacetyl-glycyl-D,L-phenylalanine. Synthesis of the dipeptide 50% aqueous tetrahydrofuran was effected at room temperature by treatment of D,L-phenylalanine anion with N-trifluoroacetyl-glycine thio-phenyl ester. The optical integrity was verified by studying the properties of N-trifluoroacetyl-L-phenylalanine. Hydrolytic cleavage of the trifluoroacyl-nitrogen bond yielded the optically active amino acid of unchanged rotation. Conversion of the acyl-amino acid to the anilide, followed by mild hydrolysis led to the isolation of L-phenylalanyl-anilide. These observations indicate that thiol esters of N-trifluoroacetyl-amino acids may find application in the controlled formation of the peptide bond in aqueous media. (auth)

### 124

MAMMALIAN CONVERSION OF  $\text{C}^{14}$  CARBOXYL-LABELED 3-HYDROXYANTHRANILIC ACID INTO  $\text{N}^1$ -METHYLNICOTINAMIDE. L. V. Hanks and M. Urvitsky (Brookhaven National Lab., Upton, N. Y.). *Arch. Biochem. and Biophys.* **52**, 484-5(1954) Oct.

Data are presented from studies using  $\text{C}^{14}$  as a tracer which indicate that 3-hydroxyanthranilic acid functions as a precursor of  $\text{N}^1$ -methylnicotinamide in the rat. (C.H.)

### 125

BIOSYNTHESIS OF  $\text{C}^{14}$ -SPECIFICALLY LABELED CELLULOSE BY ACETOBACTER XYLINUM. II. FROM D-MANNITOL-1- $\text{C}^{14}$  WITH AND WITHOUT ETHANOL. Francis W. Minor, Anthony M. Schwartz, and Milton Harris (Harris Research Labs., Washington, D. C.) and Glenn A. Greathouse and Harold G. Shirk (National Research Council, Washington, D. C.). *J. Am. Chem. Soc.* **76**, 5052-4(1954) Oct. 20.

Cellulose- $\text{C}^{14}$  was biosynthesized by *Acetobacter xylinum* employing D-mannitol-1- $\text{C}^{14}$  as the sole labeled nutrient. Label distribution in the D-glucose from the bacterial cellulose showed 84 to 96% of the activity was located at positions 1 and 6, with the residual activity being at positions 2 to 5. These data indicate that some of the scission products from the original D-mannitol became oriented in the cellulose. The labeled cellulose had lower specific radioactivity than the D-mannitol-1- $\text{C}^{14}$  supplied. The presence of ethanol in the culture media, although it increased the yield of cellulose as well as its  $\text{C}^{14}$  content, did not affect the distribution of the label among the carbons of the glucose making up the cellulose. (auth)

## TRITIUM AND TRITIUM COMPOUNDS

### 126

THE RELATIVE ABUNDANCE OF HT AND HTO IN THE ATMOSPHERE. P. Harteck (Rensselaer Polytechnic Inst., Troy, N. Y.). *J. Chem. Phys.* **22**, 1746-51(1954) Oct.

A kinetic discussion of the HT and HTO formation in the atmosphere indicates that the ratio of about 1 HT to 1000 HTO in nature and the very high T concentration of



$4 \times 10^{-15}$  in atmospheric hydrogen compared with about  $3 \times 10^{-10}$  in normal rain water can only be understood by means of a photochemical reaction. Since the tritium atoms are quickly removed by oxygen molecules in three-body collisions and form the  $\text{TO}_2$  radical which in turn forms HTO, the  $\text{TO}_2$  must be photochemically dissociated. The T atoms thus set free collide repeatedly with hydrogen atoms and undergo to a certain extent the exchange reaction  $\text{H}_2 + \text{T} = \text{HT} + \text{H}$ . On the other hand, the T atoms or  $\text{TO}_2$  radicals may react with ozone to form a OT radical which combines with the hydrogen of the atmosphere into HTO. In low altitudes the reaction of  $\text{TO}_2$  with air polluting bodies form HTO predominately. The ratio of these reactions is responsible for the ratio of HT and HTO in nature with the HTO brought down into the surface waters by rainfall. (auth)

## URANIUM AND URANIUM COMPOUNDS

127

Argonne National Lab.

A STUDY OF THE EXPLOSIVE PROPERTIES OF URANIUM-ZIRCONIUM ALLOYS. Robert P. Larsen, Roberta S. Shor, Harold M. Feder, and D. Stanley Fliikkema. July 1954. 22p. Contract W-31-109-eng-38. (ANL-5135)

The explosion of uranium-zirconium alloys on treatment with nitric acid was investigated. The cause of the explosion was clarified, and its mechanism ascertained. The existence of the epsilon phase, a hitherto questionable feature of the uranium-zirconium phase diagram, has been verified. The prevention of explosions during pickling, etching, or dissolution of these alloys has been studied; recommendations are made for safe handling. (auth)

128

Hanford Works

CATHODIC VACUUM ETCHING OF URANIUM. T. K. Bierlein. Aug. 11, 1954. Decl. Sept. 28, 1954. 13p. Contract W-31-109-Eng-52. (HW-32676)

A cathodic vacuum etching process for U using Kr is described. Three U specimens, which were either  $\alpha$ -rolled,  $\beta$ -heat treated, or  $\gamma$ -extruded and etched with Kr at a pressure of  $75\mu$  for 1 hr at 3000 V and at a current density of about 3 ma/in<sup>2</sup> of exposed cathode, are described. Electron micrographs of the specimens and their faxfilm replicas are presented. (J.A.G.)

129

Oak Ridge National Lab.

THE CHEMISTRY OF URANIUM(IV) ORTHOPHOSPHATE SOLUTIONS; PART 1. THE SOLUBILITY OF URANIUM(IV) ORTHOPHOSPHATES IN PHOSPHORIC ACID SOLUTIONS. J. M. Schreyer. June 17, 1954. Decl. Aug. 17, 1954. 38p. Contract W-7405-eng-26. (ORNL-1747)

The present solubility measurements in the  $\text{UO}_2\text{-P}_2\text{O}_5\text{-H}_2\text{O}$  system were made at  $25^\circ \pm 0.1^\circ\text{C}$  by precipitation and dissolution techniques in the range from 1.5 to 15M total dissolved phosphate. The stable solid phase below 9.8M total phosphate was found to be  $\text{U}(\text{HPO}_4)_2 \cdot 6\text{H}_2\text{O}$  and above 9.8M,  $\text{U}(\text{HPO}_4)_2 \cdot \text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$ . The solubility of  $\text{U}(\text{HPO}_4)_2 \cdot 6\text{H}_2\text{O}$  was found to increase with increasing phosphate concentration from  $2 \times 10^{-4}$ M uranium at 1.5M phosphate to 0.62M uranium at 9.8M phosphate. In the metastable region above 9.8M phosphate the solubility of the hexahydrate rose to 1.25M uranium at 11.3M phosphate. From 1.5

to 11.3M phosphate the solubility of the hexahydrate can be represented by the empirical equation  $[\text{U}^{+4}] = 2.55 \times 10^{-5} [\text{PO}_4^{-3}]^{4.41}$ . The solubility of  $\text{U}(\text{HPO}_4)_2 \cdot \text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$  increased less rapidly with increasing phosphate concentration, from 0.62M uranium at the transition point to 1.3M uranium at 15M phosphate. During the investigation the following solids were identified:  $\text{U}(\text{HPO}_4)_2 \cdot \text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$ ;  $\text{U}(\text{HPO}_4)_2 \cdot 6\text{H}_2\text{O}$ ;  $\text{U}(\text{HPO}_4)_2 \cdot 4\text{H}_2\text{O}$ ;  $\text{U}(\text{HPO}_4)_2 \cdot 2\text{H}_2\text{O}$ ;  $\text{U}(\text{HPO}_4)_2 \cdot \text{H}_2\text{O}$ ; and  $\text{UP}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$ . The first two of these were separated from saturated solutions by filtering and were identified by Schreinemaker's wet-residue method. Attempts to further separate and purify them were unsuccessful due to chemical alteration to other orthophosphate solids. Acetone washing converted the hexahydrate and the  $\text{H}_3\text{PO}_4$  addition compound to the tetrahydrate and monohydrate, respectively. The latter compounds were identified by chemical analysis. The monohydrate was also produced by perchloric acid dehydration of the tetrahydrate. Thermal dehydration of the tetrahydrate gave the dihydrate, but this reverted to the tetrahydrate when exposed to the atmosphere. The tetrahydrate, which was stable under ordinary atmospheric conditions, was used as the starting material for solubility determinations. The uranium(IV) pyrophosphate hexahydrate was prepared for the purpose of establishing an x-ray-diffraction pattern. Its solubility was not determined. X-ray-diffraction patterns were obtained for all of the orthophosphate solids except the dihydrate. (auth)

130

THE ANODIC OXIDATION OF URANIUM. O. Flint, J. J. Polling, and A. Charlesby (Atomic Energy Research Establishment, Harwell, Berks, England). *Acta Met.* 2, 696-712(1954) Sept.

Over a range of 2 to 100 volts the anodic oxidation of uranium in ammoniacal ethylene glycol produces oxide films which are predominantly uranium dioxide in composition. The oxide formed in this manner shows considerable stability to atmospheric corrosion. During film formation at constant current the voltage rises steeply to a plateau and subsequently increases more slowly to a second plateau. The films formed during the period of voltage rise are crystalline in character, whereas on a plateau they become amorphous. The rate of oxidation during initial voltage rise, deduced from charge assuming maximum current efficiency, is about 16 A/volt and 16 to 20 A/volt from optical thickness measurements, assuming a refractive index of 2.0 for a film of  $\text{UO}_2$ . Attention is drawn to similarities between thermal and anodic oxidation of uranium. (auth)

131

SOME OBSERVATIONS ON THE 8-QUINOLINOL AND 5,7-DIHALO-8-QUINOLINOL CHELATES OF URANIUM (VI). Therald Moeller and M. Venkata Ramaniah (Univ. of Illinois, Urbana). *J. Am. Chem. Soc.* 76, 5251-2(1954) Oct. 20.

Uranyl chelates with 8-quinolinol and its halo substitutes of both 1 to 3 and 1 to 2 types were prepared, and the absorption spectra in chloroform and ethanol were determined. The spectra of the 1 to 3 and 1 to 2 chelates of a given reagent differed only in absorption intensities. Hydrolytic decompositions are less pronounced than with the corresponding Th chelates. (J.S.R.)

132

THERMOCHEMICAL INVESTIGATION OF THE STRUC-

TURE OF DILUTE AQUEOUS SOLUTIONS OF URANYL CHLORIDE AND NITRATE. I. I. Lipilina and O. Ya. Samoilov. *Doklady Akad. Nauk S.S.S.R.* **98**, 99-102(1954) Sept. 1. (In Russian).

### 133

POLAROGRAPHIC DETERMINATION OF URANIUM. D. I. Legge (Anglo-Transvaal Consolidated Investment Co., Ltd., Johannesburg, South Africa). *Anal. Chem.* **26**, 1617-21(1954) Oct.

A more rapid and accurate method for the determination of U in ores and process samples is presented. The U was first separated from the bulk of the other metallic impurities by eluting an  $\text{HNO}_3$ -ether solution through a short column of cellulose pulp, then determined polarographically in an electrolytic containing oxalic and sulfuric acids. Small quantities of a large number of impurities had no effect. Low-grade samples were analyzed with greater accuracy. Complete analysis was done in about 3 hr, and routine analysis took under half an hour. (J.A.G.)

### 134

FLUOROMETRIC AND COLORIMETRIC MICRODETERMINATION OF URANIUM IN ROCKS AND MINERALS. J. A. S. Adams and William J. Maeck (Univ. of Wisconsin, Madison). *Anal. Chem.* **26**, 1635-9(1954) Oct.

A system of operations and manipulations was developed for analyzing geologic specimens containing less than 10 ppm of uranium. Means of opening the sample, as well as cellulose chromatographic and ethyl acetate extraction procedures for the separation of uranium from interfering elements, have been investigated and compared. The fluorometric procedure has been critically studied and compared with Yoe's colorimetric procedure. In general, samples containing less than 10 ppm of uranium are best analyzed fluorometrically; more than 10 ppm colorimetrically. (auth)

### 135

INVESTIGATION ON THE CO-ORDINATIVE POWER OF URANYL. PART II. ABSORPTION SPECTRA OF THE COMPLEXES WITH  $\beta$ -DIKETONES. L. Sacconi and G. Giannoni (Università di Firenze, Italy). *J. Chem. Soc.*, 2751-5(1954) Aug.

Absorption spectra of anhydrous and aqueous organic solutions of uranyl complexes afford experimental evidence of the existence of strong bonds (essentially covalent) between the uranium central atom and the ligands, and show that the complexes are solvated and hydrated to a high degree. This supports the conclusion that in such complexes uranium (VI) exhibits a coordination number greater than 6. (auth)

## ENGINEERING

### 136

Petroleum Refining Lab., Penna. State Univ. Coll. of Chemistry and Physics  
FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. QUARTERLY REPORT FOR APRIL, MAY, AND JUNE 1954. Sept. 10, 1954. 86p. Contract AF33(038) 18193. (PRL-5.11)

### 137

16TH BIENNIAL MATERIALS OF CONSTRUCTION REPORT. PART I. SURVEY OF MATERIALS. PART II.

CORROSION DATA CHARTS. PART III. DIRECTORY OF MATERIALS. *Chem. Eng.* **61**, No. 11, 171-234(1954) Nov.

Various metals, alloys, plastics, polymers, rubbers, cements, and fluorinated resins are surveyed as to corrosion resistance, physical and mechanical properties, applications, forms available, and ease of fabrication. Corrosion data charts of 36 materials vs. 48 corrosives are included to assist the searcher in narrowing his field of choice. The directory of corrosion-resistant materials (13 pages) lists the material by trade name, the manufacturer, a description, and the most important applications. (L.M.T.)

## HEAT TRANSFER AND FLUID FLOW

### 138

Los Alamos Scientific Lab.

INTERFACE INSTABILITY OF THE HELMHOLTZ TYPE. G. F. Carrier. [nd] 22p. Contract [W-7405-Eng-36]. (AECU-2948)

The interface instability of two viscous fluids was studied whose relative motion is characterized by a velocity distribution such as arises when a shock wave passes obliquely from one medium to the other or when shocks travel along the interface oriented normal to the interface. (L.T.W.)

### 139

North American Aviation, Inc.,  
HIGH TEMPERATURE LIQUID METAL CIRCULATING SYSTEM. R. D. Keen. Aug. 1, 1954. 45p. Contract AT-11-1-GEN-8. (NAA-SR-985)

To explore the feasibility of operating a heat transfer system at very high temperature, a figure-eight loop using forced convection was designed and built. Graphite was selected as the high-temperature construction material, and methods of fabricating and assembling this material were developed. Since tin, which was used as the working fluid, proved to be a powerful solvent at high temperature for most other metals, the system (including a centrifugal pump) was arranged so that the liquid tin was in contact with nothing but graphite. After preliminary changes were made it was found possible to operate this system continuously for over 500 hours at temperatures ranging up to 1500°C without leaks or other serious difficulties. Temperature data were obtained from which an estimate was made of the heat transfer film coefficient for liquid tin to graphite, as a function of fluid velocity. (auth)

### 140

HEAT TRANSFER IN CROSS-FLOW HEAT EXCHANGERS AND PACKED BEDS. EVALUATION OF EQUATIONS FOR PENETRATION OF HEAT OR SOLUTES. A. Klinkenberg (N. V. De Bataafsche Petroleum Maatschappij (Royal Dutch/Shell Group), The Hague, Netherlands). *Ind. Eng. Chem.* **46**, 2285-9(1954) Nov.

A critical survey is given of various methods for evaluating the solutions of a set of equations frequently met in heat and mass transfer problems—viz., in double cross-flow heat exchangers and in percolators (heating of packed beds, chromatography, etc.). The solutions give two temperatures or concentrations expressed in two dimensionless parameters, Y and Z, representing two length coordinates or a length and a time coordinate for the cross-flow heat exchangers and the percolators, respectively. (auth)

### 141

SPINED TUBES IN EXCHANGERS. HEAT TRANSFER



**CHARACTERISTICS.** M. Hobson and J. H. Weber (Univ. of Nebraska, Lincoln). *Ind. Eng. Chem.* **46**, 2290-4 (1954) Nov.

Heat and momentum transfer in spined tubes, shaped from the metal of the parent tube and with significant variations in surface properties, applied to annuli using air as the test fluid are discussed. Frictional data are correlated on the basis of two parameters characterizing the relative roughness of the surface. Heat-transfer data are expressed by  $Nu = 0.00168(Re)^{1.46}(Pr)^{1/4}$ . (J.A.G.)

## MATERIALS TESTING

### 142

Lewis Flight Propulsion Lab., NACA  
**THEORY OF THERMAL SHOCK RESISTANCE OF BRITTLE MATERIALS BASED ON WEIBULL'S STATISTICAL THEORY OF STRENGTH.** S. S. Manson and R. W. Smith. [1953] 44p. (NP-5336)

Use is made of the concepts of Weibull to predict the behavior of circular disks of brittle materials subjected to peripheral thermal shock. It is found that fracture most probably occurs not at the time when the surface stress is a maximum, but at a later time when the surface stress has fallen somewhat, but a greater volume of material in the interior of the disk has been brought up to moderate stress level. Utilizing the "risk of rupture" concept introduced by Weibull, a general relation is established for relating the conditions of fracture under varying degrees of quench severity. The analysis indicates that for materials having low material homogeneity factors,  $m$ ,—or materials in which the tensile strength differs appreciably from the bending strength—considerable error can be introduced by the use of the conventional maximum stress theory of fracture to relate the fracture conditions under mild and severe quenches. Errors as high as 30% can be expected in some practical cases. It is also suggested how thermal shock data can be used to evaluate the material constant  $m$ . Analysis of limited data on the thermal shock characteristics of steatite disks indicated that for this material the experimentally determined value of  $m$  was sufficiently high to obscure possible small discrepancies arising from the use of the maximum stress theory of fracture. The value of  $m$  as deduced from the thermal shock tests was in very good agreement with the value determined from a statistical study of the bending strengths of twelve small specimens. More data on a variety of materials would, however, be desirable for a full evaluation of the proposed theory particularly for cases involving low values of  $m$  for which the largest discrepancies arise. (auth)

## RADIOGRAPHY

### 143

Los Alamos Scientific Lab.  
**EVALUATION OF THE POLAROID PROCESS FOR INDUSTRIAL RADIOGRAPHY.** James W. Dutli and James F. Torbert. Oct. 18, 1954. 19p. Contract [W-7405-eng-36]. (AECU-2955)

The characteristics of Polaroid Radiographic Packet No. 1001 are described for 200 pkv x-ray exposure for salt-, lead-, and no-intensifying-screen techniques. Calculated and experimentally determined minimum radiographic sensitivity data are given. Radiographic data are included on exposure curves, sensitivities, and resolutions for aluminum and steel absorbers with a broad range of x-ray

energies and  $Co^{60}$   $\gamma$  rays. It is concluded that the Polaroid paper is best suited for low-energy radiography of high-contrast specimens. (auth)

## VACUUM SYSTEMS

### 144

Livermore Research Lab., Calif. Research and Development Co.

**DESIGN OF A LARGE VACUUM VESSEL.** F. L. Maker. June 1954. 69p. Contract AT(11-1)-74. (LRL-157)

A horizontal vacuum vessel 60 ft in diameter by 87 ft long was designed and built. Many novel design features are described. These included use of both longitudinal and circumferential stiffeners and spherical segment heads turned inward, with compression ring reinforcement at the edges. The design is described, and the method of determining the distribution of the load between shell, longitudinal stiffeners, and circular ribs is developed, as well as the computation of the discontinuity stresses at the edge of the head. (auth)

### 145

Clinton Engineer Works, Tennessee Eastman Corp.  
**VACUUM PROBLEMS AND TECHNIQUES.** C. E. Normand, Frank A. Knox, G. W. Monk, Alan J. Samuel, and W. R. Perret. Jan. 1950. Decl. June 18, 1954. 289p. Contract W-7401-eng-23. (TID-5210; NNE-1-11)

Routine production of high vacuum in large systems on a scale never previously undertaken was required in the operation of the electromagnetic separation process for U isotopes and the information gained which is applicable to the solution of vacuum problems is presented. The original equipment used is described and its performance is evaluated. The most significant improvements in efficiency which resulted from changes in operating techniques are presented. The materials used, cold traps and refrigerants, instrumentation, vacuum testing and leak detection, and pump-down and outgassing are discussed. (J.S.R.)

### 146

**ALL-GLASS VALVES FOR USE IN OBTAINING ULTRA HIGH VACUA.** Richard W. Decker (Westinghouse Research Labs., East Pittsburgh, Penna.). *J. Appl. Phys.* **25**, 1441-2 (1954) Nov.

The valve consists of a ground seat, sealed in glass tubing with a glass-enclosed iron slug ground to fit the seat. The valve is opened and closed by moving the ground slug in and out of the seat by an external magnet. Two alternative constructions are shown in which the valve joint is constructed of a standard ground glass ball joint; this reduces the cost and in general provides a better seat. In a vacuum system with a manifold volume of 1 liter, a pressure of  $<1 \times 10^{-9}$  mm Hg was obtained and maintained for a week. (L.M.T.)

## MINERALOGY, METALLURGY, AND CERAMICS

### 147

Rock Island Arsenal Lab.  
**PROTECTIVE FINISHES (OTHER THAN ORGANIC) FOR METALS.** REPORT NO. 4. POROSITY OF NICKEL

## DEPOSITS BY AUTORADIOGRAPHIC TECHNIQUE.

Russell H. Wolff and Mary Ann Henderson. Mar. 1, 1954. 38p. (RIA-54-24; AD-28821)

A series of steel specimens were plated with radio-active iron. Duplicate specimens were overlaid with nickel. The nickel films were evaluated for coating discontinuities by use of photographic film suitably exposed to radiation through the nickel from the radioiron plate. The autoradiographs so produced were examined for evidence of pores in the same manner as any other x-ray picture. The test specimens were also subjected to a coating continuity boil test in distilled aerated water of pH range 6.5 to 7.0 for 30 minutes. Results obtained were compared with the autoradiographs. (auth)

## 148

BUBBLE-MINERAL ATTACHMENT IN FLOTATION. L. F. Evans (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia). *Ind. Eng. Chem.* 46, 2420-4(1954) Nov.

A theoretical approach to the flotation process is presented in a study of the adhesion process by pressing a captive air bubble against a hydrophobic surface submerged in water. In the induction period, the elapsed time between the moments of apparent and true contact, it is shown that the bubble is not stationary and that the water film which separates the bubble from the solid surface drains continuously through a restricted outlet. The problem is dealt with in three parts: first, the concept of "rupture thickness" is introduced, and a method for its determination described; the collision between a particle and a bubble is then examined, and an expression for the time available for contact is derived; finally, the shape of the bubble pressed against a hydrophobic surface is studied, and the possibility of calculating the induction period is discussed. (L.M.T.)

## 149

SOME EXPERIENCES WITH A NEW METALLURGICAL MOUNTING PLASTIC. P. A. Lovett. *Metallurgia* 50, 201-3(1954) Oct.

Following a brief outline of a method of mounting micro-specimens in a new cold-setting plastic, prior to grinding and polishing, a number of points which have arisen during twelve months use of the process is discussed. (auth)

## CERAMICS AND REFRACTORIES

## 150

American Electro Metal Corp.  
CEMENTED BORIDES (PHYSICAL PROPERTIES). SUMMARY PROGRESS REPORT [FOR] MAY 1, 1953 TO JULY 31, 1954. F. W. Glaser and M. J. Ford. 24p. (Includes Reprint, TRANSITION METAL DIBORIDES. Benjamin Post, Frank W. Glaser, and David Moskowitz. *Acta Met.* 2, 20-5(1954)). Contract N6-ONR-256. (NP-5364)

Measurements are presented on the following properties of Borolite III and IV: densities, melting points, electric resistivities, Rockwell "A" hardnesses, specific heats at 500 and 1000°C, transverse rupture strengths at 1800°F, stress-to-rupture properties at 1800 and 2000°F, thermal expansions from room temperature to 1000°C, thermal shock, impact tests at room temperature, and oxidation in stagnant air at 1000°C for 1000 hr. Additional results on Borolite III thermal conductivities at 20 and 100°C and moduli of elasticity at room temperature and 1000°C are included. The reprint bound in this report on Transition

Metal Diborides has been abstracted separately as NSA 8-1830. (For preceding period see NP-4548.) (J.A.G.)

## 151

KILN REACTOR KEY TO NEW ZIRCONIA PROCESS. *Chem. Eng.* 61, No. 11, 124, 126(1954) Nov.

The production of zirconia by reaction of zircon sand and dolomite in a rotary kiln at 2500°F is briefly described. The stability and melting point are compared with other oxides. Cost factors, description of the kiln, and uses of zirconia are discussed. (J.A.G.)

## CORROSION

## 152

Los Alamos Scientific Lab.

[MATHEMATICAL STUDIES OF GALVANIC CORROSION]. PART 3. SEMI-INFINITE COPLANAR ELECTRODES WITH EQUAL CONSTANT POLARIZATION PARAMETERS. James T. Waber. [1954]. 45p. Contract [W-7405-eng-36]. (AECU-2954)

The mathematical analysis of a coplanar alternating array of long narrow electrodes was conducted, subject to the limitation that the polarization parameters for the anodes and cathodes are constant and equal. The interfacial potential and corrosion current parameters were computed for a total of 18 values of  $a/x$  and for  $a/c$  equal to  $\frac{1}{2}$  and  $\frac{1}{4}$ . Four perspective drawings of the distribution of potential throughout the corroding were made to scale to illustrate the influence of polarization. Two experimental studies were found to be in reasonably good agreement with the present theoretical analysis. (auth)

## 153

DuPont de Nemours, E. I., and Co. Explosives Dept., Atomic Energy Div.

TREATMENT OF DISASSEMBLY BASIN WATER. F. A. Locke. Oct. 1954. 14p. Contract AT(07-2)-1. (DP-81)

Corrosion of steel piping and basin equipment was found to be the main cause of the deposition of a brown flocculent material on the floor and walls of a pile disassembly basin. A combination of sodium dichromate and chloramine, the best of seven water treatments tested, reduced steel corrosion 50%, zinc corrosion 80%, and met the standards for control of turbidity and bacteria in the water of the basin. (auth)

## 154

Knolls Atomic Power Lab.

CORROSION OF REACTOR STRUCTURAL MATERIALS IN HIGH-TEMPERATURE WATER. 1. DESCALING METHODS. R. Fowler, Jr., D. L. Douglas, and F. C. Zyzye. Aug. 27, 1954. 30p. Contract W-31-109-Eng-52. (KAPL-1198)

Three descaling techniques have been found suitable for removing the oxide layers formed on ferrous and nickel alloys when the latter are corroded in high-temperature water. These three methods are (1) cathodic treatment in inhibited sulfuric acid, (2) immersion in a sodium hydride bath, and (3) immersion in Clarke's solution. The results of an extensive investigation of the descaling blanks (metal loss suffered by a clean metal specimen), the materials for which each descaling procedure is effective, and important variables are reported. (auth)

## 155

Los Alamos Scientific Lab.

MATHEMATICAL ANALYSIS OF GALVANIC CORROSION.



#### PART 4. EFFECT OF POLARIZATION AND LIQUID THICKNESS ON THE TOTAL CORROSION CURRENT.

James T. Waber. June 1954. 7p. Contract W-7405-eng-36. (LA-1686)

The expressions for total current and for average current density were derived for finite and infinite thicknesses of the corrosion medium. In the event that the polarization parameters are equal, the variation in average current density with the relative amount of the anodic phases is symmetrical about a maximum current density value for a 50-50 mixture. This is in qualitative agreement with Robertson and Uhlig's work. (For preceding report in series see AECU-2954.) (auth)

#### 156

EFFECT OF WETTING AGENTS ON CORROSION. IV. PROTECTIVE EFFECT IN ACID MEDIUM. Luigi Piatti. Translated by W. A. Kee from *Werkstoffe u. Korrosion* 4, 153-6(1953). 7p. (AEC-tr-1965)

The protective influence of Sapamin CH (the chlorohydrate of a monocyclic diamine) for carbon steel in acid media was studied. The investigations showed that good protection can be given to alloy steels through the presence of a wetting agent in an acid medium. (J.S.R.)

#### 157

A POTENTIOSTAT FOR CORROSION STUDY. M. H. Roberts (Brown-Firth Research Labs., Sheffield, England). *Brit. J. Appl. Phys.* 5, 351-2(1954) Oct.

The potential difference between a standard electrode and a test electrode in an electrolytic cell forms the input to a thermionic d-c amplifier. The output current of the amplifier flows between the test electrode and a third electrode of platinum. Any change in potential of the test electrode alters the output current to reduce the charge, the system forming a closed-loop proportional controller. The two-stage amplifier is symmetrical, so that zero or reverse current can be obtained without loss of sensitivity. An output of 20 ma can be supplied with less than 100 mv variation of electrode potential. (auth)

#### 158

CORROSION OF METALS BY MEANS OF CHLORINE AT HIGH TEMPERATURES. Kh. L. Tseitlin. *Zhur. Priklad. Khim.* 27, 953-8(1954) Sept. (In Russian).

The corrosion of Al, C steel, Cu, stainless steel, and Ni by dry and wet  $\text{Cl}_2$  at varying  $\text{Cl}_2$  addition rates was studied between 260 and 300°. The data are tabulated. (J.S.R.)

#### GEOLOGY AND MINERALOGY

#### 159

American Cyanamid Co., Atomic Energy Div., Watertown, Mass.

URANIUM RECOVERY FROM THOMAS RANGE, UTAH, FLUORSPAR. F. W. Blocher, Jr. Jan. 11, 1952. Decl. Sept. 16, 1954. 28p. (ACCO-16)

Methods of recovering uranium from Thomas Range, Utah, fluorspar samples were studied. Although at the present time none of the Thomas Range fluorspar is being made into hydrofluoric acid, test work indicates that the only feasible way of recovering the contained U is to water leach the  $\text{CaSO}_4$  residue remaining after conversion of the fluorspar to  $\text{HF}$  by reaction with  $\text{H}_2\text{SO}_4$ . In one test such a leach with plain water effected an 89% U extraction. Results of a large number of hydrometallurgical tests on the ore indicated that nondestructive leach methods were not economically

practical for U recovery. Some typical results are summarized. Results of leach tests on raw ore show that U extraction appears to vary directly with the amount of fluorite dissolved. The occurrence of most of the U as  $\text{UO}_2$  in intimate isomorphic mixture with the  $\text{CaF}_2$  is probably responsible for the refractory nature of the ore. (auth)

#### 160

Grand Junction Operations Office, AEC  
DRILLING AT POLAR MESA, GRAND COUNTY, UTAH AND REVIEW OF FAVORABILITY CRITERIA USED. Robert L. Redmond and John P. Kellogg. June 1954. 21p. Contract AT(30-1)-1265. (RME-22(pt.1))

On Polar Mesa in Grand Co., Utah, a total of 37,904 ft was drilled by the Commission in 1950. The mesa was again drilled during the period June 1952 to February 1953, which totaled 49,838 ft. This report deals primarily with the most recent project. The principal uranium-vanadium-bearing unit of the Salt Wash sandstone is approximately 270 ft above the Entrada-Summerville contact. It is a massive yellow-brown sandstone ranging in thickness from 10 to 70 ft. A method of correlation involving the projection, parallel to the regional dip, of a constant thickness of sediments was an aid in exploration drilling. Use of the constant-thickness method resolved the difficulty of correlation in the rapidly changing lithology of the Salt Wash. Subsurface maps constructed on lithology encountered in the 45-ft constant-thickness unit indicated favorable areas in which subsequent drilling located ore bodies or extended the boundaries of known favorable ground. This method of correlation offers two economic advantages. One is a saving in drilling time accomplished by taking a smaller margin of core above and below the arbitrary unit. The other advantage is a saving in coring expense by drilling a smaller but fixed amount of core per hole by bottoming the hole at a shallower depth than is possible with the lithologic unit correlation. (auth)

#### 161

Division of Raw Materials, AEC  
PRELIMINARY REGIONAL MAPPING IN THE RUBY QUADRANGLE, ARIZONA. Bruce P. Webb and Kirby C. Coryell. May 1954. 11p. (RME-2009)

Reconnaissance mapping in the Ruby Quadrangle, Ariz., indicates the existence of a complex assemblage of volcanic rocks and associated sediments, divisible into a younger and older series. The young series consists of flat-lying tuffs, lavas, and tuffaceous conglomerates of late Cenozoic (?) age. The extent and structural pattern of these rocks can largely be determined from air photo study. The older series consists of (acidic and intermediate) lavas, tuffs, conglomerates, and associated sediments of Mesozoic (?) age, locally folded and extensively intruded by a dioritic magma. Uranium mineralization is thought to be confined to the acidic lava member of the older series. Further field work will be necessary to determine the extent and structure of the favorable formations. (auth)

#### 162

Geological Survey  
MINOR ELEMENTS IN SOME ROCKS, ORES, AND MILL AND SMELTER PRODUCTS. E. P. Kaiser, B. F. Herring, and J. C. Rabbit. Apr. 1954. 119p. (TEI-415)

A collection of nearly a thousand spectrographic analyses was started at the request of the War Production Board in 1942. Its purpose was the search for strategic metals in domestic mill and smelter products. Subsequently analyses of raw materials of many types were

added. The analyses are grouped by states and by major mineral raw materials. The samples vary widely in character and in kind of material. They were analyzed chiefly by spectrographic methods, the accuracy of which increased during the later stages of the work. The significance of the analyses depends on choice of sample localities, sampling errors, analytical errors, and the availability of replicate analyses. The analyses show many significant relations, for example, the presence of cobalt in copper and zinc concentrates, of nickel, molybdenum, tin, and vanadium in Wisconsin lead-zinc ores, and of niobium in Arkansas bauxite. (auth)

#### 163

URANIUM IN SOUTH AFRICA. Atomics 5, 286-7(1954) Oct.

#### 164

OCCURRENCES OF URANIUM IN CARBON COUNTY, PENNSYLVANIA. Harry Klemic and R. C. Baker (U. S. Geological Survey, Washington, D. C.). U. S. Geol. Survey Circ. 350, 1954. 8p.

An occurrence of uranium in Carbon County, Pa., was known in 1874. Three other deposits were discovered in 1948 and 1953 by reconnaissance parties of the U. S. Geological Survey. Uranium vanadates, carbonates, and silicates occur in coarse graywacke conglomerate near the base of the Pottsville formation, of Pennsylvanian age, on the north limb of the Panther Valley syncline and on the south limb, autunite and uranium silicates occur in graywacke sandstones near the top of the Catskill formation of Devonian age. Uraniferous graywacke sandstone occurs in the upper part of the Catskill formation near Butcher Hollow and near Penn Haven Junction in minor anticlines of the Broad Mountain anticline. Small amounts of kasolite and galena occur in the vicinity of Penn Haven Junction. All three uranium deposits in the Catskill formation appear to be in the Cherry Ridge redbeds of Willard. The presence of 4 uranium deposits in rocks of 2 different types and ages, within a limited area, suggests that other deposits may be found by additional prospecting. Detailed study and geologic mapping of the area are planned. (auth)

#### 165

OCCURRENCES OF RADIOACTIVE MINERALS IN THE BALD MOUNTAIN GOLD-MINING AREA, NORTHERN BLACK HILLS, SOUTH DAKOTA. R. C. Vickers (U. S. Geological Survey, Washington, D. C.). U. S. Geol. Survey Circ. 351, 1954. 8p.

Six radioactive occurrences were found in July 1953 during a reconnaissance of the Bald Mountain gold-mining area, Lawrence County, S. Dak. The rocks in the area consist mainly of the flat-lying Deadwood formation of Cambrian age intruded by many sills, laccoliths, and dikes of Tertiary age. Associated with the intrusive rocks are gold-silver deposits which have been interpreted as being localized by solutions migrating up fractures and replacing favorable beds, mainly in the Deadwood formation and the overlying Whitewood limestone and in altered intrusive rocks. Samples contain as much as 0.19% equivalent uranium and also contain thorium and the rare earths. All the occurrences are in the weathered zone, and differential leaching has probably disturbed the original thorium/uranium ratio. The increase in rare-earth content toward the center of the gold-producing area and the occurrence of uranium minerals (autunite and torbernite) on the fringe of the productive area are proba-

bly related to a zonal pattern. Although none of the occurrences are large enough to constitute ore, uranium-bearing hydrothermal solutions were probably present during Tertiary mineralization in the Bald Mountain area and may have given rise to the carnotite-type deposits in the sediments surrounding the Black Hills. (auth)

#### 166

ADSORPTION OF A MERCAPTAN ON ZINC MINERALS. A. M. Gaudin (Massachusetts Inst. of Tech., Cambridge) and D. L. Harris (Univ. of Wisconsin, Madison). Mining Eng. 6, 925-8(1954) Sept.

Observations were made of the distribution of mercaptan containing  $S^{35}$  between aqueous solution and mineral and between aqueous solution and the gaseous phase. Although equilibrium may not have been attained, adsorption of the reagent was shown to occur readily from air or aqueous solution on sphalerite, zincite, and willemite and to correspond to flotation. Adsorption on quartz did not similarly occur. (auth)

#### METALS AND METALLURGY

#### 167

[General Engineering Lab.], General Electric Co. NON-DESTRUCTIVE INSPECTION OF ADHESIVE BONDED SHEET METAL. INTERIM MONTHLY PROGRESS REPORT [NO.] 20, FEBRUARY 1, 1954-MARCH 1, 1954. [Edward Niemann, Jr. Mar. 15, 1954]. Contains an Appendix: EDDY CURRENT BOND THICKNESS MEASUREMENT. R. E. Bell and J. P. Walden. Mar. 3, 1954. 19p. Contract AF 33(600) 17322. (AD-28855)

The results of the investigation to determine the feasibility of using eddy currents for measuring the thickness of the bond line are presented. Experimental bread-board equipment was built, and good correlation was obtained between actual thickness and the thickness indicated by the instrument. The maximum error was about 0.0015 in., caused in large part by circuit drift which could be improved substantially by refinements. The application of this instrument for determining the strength of FM-45 tapeless adhesive appears practical based on the results of tests. (auth)

#### 168

Engineering Research Inst., Univ. of Mich. A STUDY OF CREEP OF TITANIUM AND TWO OF ITS ALLOYS. PROGRESS REPORT NO. 13 COVERING THE PERIOD OCTOBER 1, 1953 TO DECEMBER 31, 1953. J. V. Gluck and J. W. Freeman. 13p. Contract AF33(038)-14111. (AD-32009)

Creep test results for Ti 75A at 76°F after annealing at 1800°F (above  $\alpha/\beta$  transition temperature) are given. A somewhat better creep resistance and a slightly higher yield strength than for a 1600°F treated material are reported. Stress-creep data on transverse samples of heat-treated RC 130A at 76 and 600°F are given. Tests were also run at 76°F on predominantly  $\beta$  structures of RC 130A briefly exposed at 400°F. At both 76 and 600°F transverse sections had more creep resistance than longitudinal sections. An embrittling effect was found for 400°F exposed predominantly  $\beta$  structures. Tests were also run on Ti 150A samples in the direction transverse to the rolling direction. Check tests were run on the as-received material at 76 and 600°F and the 1500°F air-cooled condition at 400 and 600°F. Again, better creep resistance was found



in the transverse direction than in the longitudinal direction. (J.A.G.)

169

Ames Lab.

PREPARATION OF ZIRCONIUM METAL. Kenneth Albert Walsh. July 14, 1950. Decl. with deletions Sept. 20, 1954. 56p. Contract W-7405-eng-82. (AECD-3640)

The preparation of high-purity Zr by exothermic chemical bomb reduction of  $K_2ZrF_6$ ,  $ZrCl_4$ , and  $ZrF_4$  with Ca is reported. The metallic phase contained an alloying addition of Zn to decrease the melting point and to diminish the interaction with the refractory liner inserted in the bomb. Hafnium-free Zr was freed from other metallic impurities by crystallizing  $ZrOCl_2$  from hydrochloric acid solutions. Contamination of Zr and Zr compounds was reduced with respect to C by the same process.  $ZrF_4$  monohydrate was precipitated from a 48% HF- $ZrOCl_2$  solution, dried in Pt-lined Cu trays, and converted to anhydrous  $ZrF_4$  by dehydration in an atmosphere of HF at 500°C for 5 hr using Mg-lined Monel trays in a Monel reactor. Less pure  $ZrF_4$  was prepared by the action of HF with  $ZrCl_4$  at 50°C in graphite trays enclosed in a Cu container, and by ignition of  $ZrOCl_2$  at 250°C and treatment with HF gas. Oxide and other impurities were removed by vacuum sublimation at 750 to 800°C. The use of I with Ca in the reduction charge initiated the reaction between  $ZrF_4$  and Ca and supplied additional heat to fuse the reaction products. Complete removal of S, when used in place of I, from the Zr product was not possible. The recovery of Zr was more efficient with excess Ca. Ductile Zr was obtained with a reduction charge containing 400 g of  $ZrF_4$ , 40 g of Zn, 64 g of I, and 223 g of Ca. The regulus recovered in the bomb reduction was an alloy of Zr and Zn. Induction heating of the alloy in vacuum removed Zn, Ca, and other volatile impurities. The practical use of larger bombs with larger charges was demonstrated. (J.A.G.)

170

Atomic Energy Research Establishment, Harwell, Berks (England)

THE SURFACE TENSION OF LIQUID METALS AND ALLOYS. J. W. Taylor. May 4, 1954. 62p. (AERE-M/TN-24)

Existing information on the surface tensions of liquid metals and alloys is reviewed. Methods of measurement are discussed critically to permit the selection of most accurate experimental values. Interpretations of surface tension data in terms of the molecular form of the liquid metal state are presented, and the limitations and inaccuracies of these analyses are indicated. Several physico-mathematical treatments of the surface energies of liquid metals are considered, and the calculated surface tensions are compared with the experimental values for a number of metals. It is shown that such treatments can in general only indicate the order of magnitude of the surface tension for the majority of metals. A number of empirical relationships between the surface tension of metals and other physical properties are presented, and the theoretical basis for these correlations are established. (auth)

171

Aeronautical Materials Lab., Naval Air Experimental Station, Philadelphia

THE INVESTIGATION OF SPOT WELDING OF PLATED LOW CARBON STEELS. C. M. Dougherty. Oct. 9, 1950. 25p. (AML-NAM-25789(pt.2))

Spot welding of rust-proofed steel components is often necessary where the complete assemblies are too large to be rust proofed after the spot-welding operation or in instances where only positions of the complete assembly require a corrosion protective coating. The corrosion characteristics, as well as the weldability, of five different corrosion preventive coatings (electrodeposited zinc, cadmium, tin, and nickel and sprayed aluminum) were investigated. A special jig was designed whereby the spot-welded shear specimens were continually flexed during corrosion tests. This procedure allowed the salt fog full access to the area of the spot weld. Resistance measurements of the surface were made on each protective coating. Shear tests of uncorroded and corroded specimens were conducted. Tensile tests of uncorroded single spot-welded tension specimens were performed. Zinc coatings have been recommended for use, with cadmium coatings as an alternate. Despite poor weldability sprayed aluminum coatings are recommended under specific circumstances. Nickel or tin coatings are not recommended. (auth)

172

Knolls Atomic Power Lab.

THE LITHIUM-SODIUM LIQUID METAL SYSTEM. O. N. Salmon and D. H. Ahmann. Aug. 20, 1954. 25p. Contract W-31-109-Eng-52. (KAPL-1205)

A brief investigation of the lithium-sodium liquid metal system was made using thermal analysis plus chemical analysis of the immiscible phases sampled at temperature. Thermodynamic principles were used to extrapolate the immiscibility loop beyond the points determined experimentally. Addition of 3.3 at.% sodium to lithium reduces the lithium freezing point from 179.4 to 171°C. At 171°C sodium and lithium form two immiscible liquid phases of composition 3.3 and 86.9 at.% sodium in equilibrium with solid lithium. The eutectic composition of the sodium-rich alloy is at 96.3 at.% sodium; the eutectic temperature is 93.4°C. (auth)

173

Battelle Memorial Inst.

EXPERIMENTAL INVESTIGATION OF NOTCH-SIZE EFFECTS ON ROTATING-BEAM FATIGUE BEHAVIOR OF 75S-T6 ALUMINUM ALLOY. W. S. Hyler, R. A. Lewis, and H. J. Grover. [Nov. 13, 1953]. 47p. (NACA-TN-3291)

This investigation was initiated to study the influence of size, particularly the notch size, on extruded 75S-T6 aluminum alloy test specimens. Unnotched and notched specimens with five different minimum-section diameters were tested. For each size a semicircular groove was tested, and for the largest diameter specimen a V-notch was also tested. A method of surface preparation was selected that would produce comparable surface finishes in different-sized notched and unnotched specimens. (NACA abst.)

174

Fansteel Metallurgical Corp.

HOT PRESSING OF BERYLLIUM CARBIDE. PROGRESS REPORT FOR THE PERIOD JUNE 1947 TO APRIL 1949. A. W. Bartok. May 11, 1949. 30p., 2 illus. [For NEPA Div., Fairchild Engine and Airplane Corp., Contract W-33-08-ac-14801(16250)]. (NEPA-1020)

Conditions are described for the hot pressing of Be carbide to a satisfactory high density. Earlier attempts and stages leading to the development of the present method are reviewed. (C.H.)

**175**

Massachusetts Inst. of Tech.

RESEARCH ON CREEP STRUCTURE CHARACTERISTICS OF TITANIUM AND ITS ALLOYS. 1. CREEP DEFORMATION CHARACTERISTICS OF IODIDE TITANIUM. 2. CREEP DEFORMATION CHARACTERISTICS OF TITANIUM ALLOYS. [PERIOD COVERED] MAY 1954–AUGUST 1954. John Lunsford, Lee Richardson, and H. J. Grant. 7p. Contract DA-19-020-ORD-2787. (NP-5355)

(For preceding period see NP-5206.)

**176**

Towne Scientific School, Univ. of Penna.

INFLUENCE OF ORDER-DISORDER TRANSFORMATION ON CREEP OF BETA-BRASS. M. Herman and N. Brown. Oct. 1, 1954. 32p. Contract DA-36-034-ORD-491, Technical Report No. 3. (NP-5368)

The creep behavior of  $\beta$ -brass was investigated over the temperature range of 330 to 500°C. The creep strength increased as the amount of long-range order increased. Calculation showed that the long-range order interacts with dislocations to produce pairs of single dislocations. The equilibrium separation of the pair of single dislocations was found to vary inversely as the square of the long-range order. For complete order the separation is  $3 \times 10^{-7}$  cm. The existing creep theories based on dislocations give a quantitative agreement with the experimental results. (auth)

**177**

Cornell Univ. Graduate School of Aeronautical Engineering

ON THE GROWTH OF PLASTIC DEFORMATION IN A BAR SUBMITTED TO LONGITUDINAL IMPACT. C[arlo] Riparbelli. Jan. 1953. 57p. Contract NAW-6141. (NP-5369)

A scheme to interpret and compute the growth of the plastic deformation in a semi-infinite bar undergoing longitudinal impact is outlined. The deformation of a bar element is interpreted as, the resultant of two deformation components: (a) elastic deformation, propagating with the speed of elastic waves of longitudinal deformation, and (b) a deformation subsequent to the establishment of the stress, called "creep," the result of which is the plastic deformation. This last is understood to be a local phenomenon, not propagating. The deformation of a semi-infinite bar submitted to end impact is computed on the basis of such a scheme. The computation is done step-by-step, each step corresponding to one element of a bar and to one time interval. At every step, two phases are considered: (a) propagation of the deformation wave as if it were elastic and (b) increment of deformation due to creep. A discussion is given of the static stress-strain relation in the light of the observed phenomena. (auth)

**178**

Battelle Memorial Inst.

THE EFFECT OF MICROSTRUCTURE ON THE MECHANICAL PROPERTIES OF TITANIUM ALLOYS. ALPHA ALLOYS. SECOND INTERIM REPORT. F. C. Holden, H. R. Ogden, and R. I. Jaffee. Sept. 1, 1954. 66p. Contract DA-33-019-ORD-1397. (NP-5374)

No basic difference was found in the equiaxed alpha structures of titanium, Ti-O, Ti-N, and Ti-Al alloys. After quenching from the beta field, serrated alpha structures without much subgrain marking were found for titanium and Ti-Al alloys. For the Ti-N alloys, subgrain markings delineating the alpha platelets are found. This

and other facts suggest a precipitation from the high-nitrogen alloys. Furnace cooling from the beta field produces subgrain markings delineating the alpha platelets both for the Ti-Al and Ti-N alloys. Increasing equiaxed-alpha grain size generally decreases strength and hardness and causes little reduction in the ductility of titanium but reduces the tensile ductility of the alloys. Increased grain size generally is beneficial to impact properties. Heat treatment from the beta field increases the yield strength of titanium but is without effect on the strong Ti-Al alloy. It causes a disappearance in yield points found in Ti-N alloys and results in a marked lowering in yield strength. Quenching from the alpha-beta field has little effect on Ti-Al alloys, but decreases the yield and tensile strength of Ti-N alloys by a combination of partition of nitrogen between the two phases, resulting in a softer matrix and elimination of strain aging. (auth)

**179**

Stanford Univ. School of Mineral Sciences

INTERDIFFUSION OF LEAD AND ZINC IN THE LIQUID STATE. FINAL REPORT. Lewis D. Hall and Stephen J. Rothman. Sept. 1954. 102p. Contract DA-04-200-ORD-178. (NP-5377)

Self-diffusion and the diffusion of trace amounts of Bi in molten Pb and the diffusion of Pb and Bi in a molten alloy of Bi and Pb were investigated. The method used was diffusion from a capillary into a reservoir of molten metal, using Pb<sup>210</sup> and Bi<sup>210</sup> as tracers. The investigation was carried out over a range of temperatures. Statistical analysis of the data showed that the activation energies for diffusion in Pb did not differ on the 50% level of significance and that the activation energies for diffusion in the Bi alloy did not differ on the 75% level, whereas the  $D_0$  values for the two matrices differed on the 99.5 and 97.5% levels, respectively. The statistical analysis also showed that the assumption of the relation  $D = D_0 \exp(-H/RT)$  was justified. The activation energies in both cases were greater than the activation energies for viscosity. Agreement with the Stokes-Einstein equation and Eyring's equations was quite poor. (auth)

**180**

Armour Research Foundation

DEVELOPMENT OF TRANSFORMATION DATA FOR SPECIAL TITANIUM ALLOYS. INTERIM TECHNICAL REPORT NO. 4 [FOR] MARCH 1, 1954–JUNE 30, 1954. A. W. Goldenstein and W. Rostoker. Aug. 6, 1954. 30p. Contract DA-11-022-ORD-1292. (NP-5379)

The isothermal transformation characteristics of a Ti alloy containing 7% Mn and 0.14% C was studied. The investigation included the establishment of a TTT chart, metallographic examination of transformed structures, and the measurement of tensile and impact properties of transformed specimens. Some correlation between mechanical properties and structure was recognized. Heat treatment conditions for optimum combinations of tensile and impact properties were established. In addition, heat treatment conditions which induce brittleness were recognized. (For preceding period see NP-5338.) (auth)

**181**

Metals Research Lab., Case Inst. of Tech.

THE EFFECTS OF STRESS CONCENTRATION AND TRIAXIALITY ON THE PLASTIC FLOW OF METALS. TECHNICAL REPORT NO. 30. THE INFLUENCE OF STRAIN RATE AND TEMPERATURE ON THE DUCTILITY



**OF AUSTENITIC STAINLESS STEEL.** G. W. Form and W. M. Baldwin, Jr. Sept. 1954. 31p. Contract N6-ONR-273/1. (NP-5400)

The ductility of AISI 303 and 310 austenitic stainless steels was determined in tensile tests over a range of strain rates from 0.01 in./in./min. up to 19000 in./in./min., and over a range of temperatures from -321°F up to +750°F. Ductility drops as strain rate is increased, the drop being greatest at room temperature at low strain rate, but at high strain rates it increases slowly and steadily with the test temperature. Magnetic measurements on broken specimens showed that the  $\gamma - \alpha$  transformation can not account for all these behaviors. (auth)

**182**

Utah Univ.

**HIGH PRESSURE OXIDATION OF METALS. TECHNICAL REPORT NO. 7. OXIDATION OF METALS UNDER CONDITIONS OF A LINEAR TEMPERATURE INCREASE.** John P. Baur, Donald W. Bridges, and W. Martin Fassell, Jr. Oct. 15, 1954. 16p. Contract DA-04-495-ORD-237. (NP-5403)

A method of studying the oxidation behavior of metals has been developed wherein the metal sample is subjected to a linear temperature increase at constant oxygen pressure. The advantages of this method over previous isothermal methods are that a rapid preliminary examination of the oxidation behavior of any metal or alloy over any temperature and pressure range can be quickly made, the region of pressure dependence can usually be found in a single experiment, and the number of samples needed is greatly reduced. The linear temperature increase method was applied to the metals Ta, Nb, Mo, Cu, Zr, Mg, Ti, and W. The results are in good agreement with those of previous investigations. Theoretical considerations show that the results could be explained by imposing the conditions of a linear temperature increase on a general type rate equation. (For preceding report in series see NP-5341.) (auth)

**183**

Minerals Research Lab., Inst. of Engineering Research, Univ. of Calif., Berkeley  
**FUNDAMENTAL STUDIES RELATED TO THE ORIGIN AND NATURE OF CREEP OF METALS. TECHNICAL REPORT NO. 11. EFFECT OF THE STRUCTURE OF DISLOCATION BOUNDARIES ON YIELD STRENGTH.** J. Washburn. May 1954. 67p. Contract N7-onr-29516. (NP-5407)

The contributions of three types of dislocation array to the strength of zinc crystals were studied. They were: (1) a pair of pure edge dislocation boundaries, (2) a complex array of pure tilt boundaries, and (3) an array of screw dislocations in the slip plane produced by a twist about the c-axis. The strengthening effects of all these substructures were found to be dependent on the temperature to which the crystal had been heated subsequent to introduction of the array of dislocations by plastic bending or twisting. An annealing temperature close to the melting point was necessary to develop an appreciable strengthening effect. In all cases the yield strength was raised, the sharpness of the yield was decreased, but the slope of the linear part of the stress strain curve characteristic of hexagonal crystals was unchanged by the introduction of dislocation arrays. Quantitative measurement of strengthening effect as a function of boundary angle and angle of twist showed a rapid increase in yield strength for very small angles

followed by decreasing increments in yield strength for additional increments of boundary angle or twist angle. As a tentative explanation for these quantitative results it was suggested that small angle boundaries may act as nuclei for the pile up of dislocation groups the stress fields of which would be sufficiently long range to interact with one another over the observed distances between neighboring slip lines. (For preceding report in series see NP-5158.) (auth)

**184**

Rem-Cru Titanium, Inc.

**CONTINUED RESEARCH AND DEVELOPMENT OF TITANIUM CASTING. FINAL TECHNICAL REPORT.** [1954]. 193p. Contract DA-19-059-ORD-1520. (NP-5409)

Four ingots each of unalloyed Ti, Ti-7Al, Ti-7Mn, and Ti-4Al-4Mn were evaluated after melting and casting with the 25-lb bottom-pour, skull, arc-melting furnace. The unalloyed Ti, the Ti-7Al, and the Ti-4Al-4Mn alloys were found to have attractive as-cast properties, including strength, ductility, and impact values; all castings had excellent chemical homogeneity. These desirable properties were also found in rods or plates fabricated out of the ingots. (For preceding report in series see NP-4896.) (L.M.T.)

**185**

Tennessee Univ.

**CALORIMETRIC STUDIES OF PLASTIC DEFORMATION AND PHASE TRANSFORMATIONS. REPORT FOR PERIOD JUNE 1, 1953-AUGUST 31, 1954.** E. E. Stansbury, G. E. Elder, and D. L. McElroy. 18p. Contract AT(40-1)-1068. (ORO-131)

Two new calorimeters were designed and constructed. The operational characteristics and the precision of measurements were improved over the previous models. A thermocouple composed of Pd and Mo is being developed. Checks of high purity Pd have shown it to be satisfactory. Mo, however, of sufficient purity not to generate parasitic thermals is not available commercially. The Pt-Pt 13% Rd thermocouple was calibrated against a standard Pt resistance thermocouple. It was determined that certain irregularities exist in experimentally determined specific heat curves. The specific heats of high purity Fe and Ni to 600°C were determined. (J.S.R.)

**186**

Cornell Univ.

**THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE ATOMIC PHENOMENA OCCURRING ON AND NEAR THE SURFACES OF SOLIDS. PART 1. SURFACE STUDIES OF SOLIDS BY TOTAL REFLECTION OF X-RAYS. PART 2. STRUCTURE OF THIN EVAPORATED COPPER FILMS BY TOTAL REFLECTION OF X-RAYS.** L. G. Parratt. Mar. 15, 1954. 68p. Contract AF-18(600)-674, Technical Report No. 1. (OSR-TR-54-13)

Analysis of the shape of the curve of reflected x-ray intensity vs glancing angle in the region of total reflection provides a new method of studying certain structural properties of the mirror surface about 10 to several hundred Angstroms deep. Dispersion theory, extended to treat any (small) number of stratified homogeneous media, is used as a basis of interpretation. Curves for evaporated copper on glass are studied as an example. These curves may be explained by assuming that the copper (exposed to atmospheric air at room temperature) has completely oxidized about 150 Å deep. If oxidation is less deep, there

probably exists an electron density minimum, perhaps just below an internal oxide seal. This seal, less than about 50 Å, perhaps 25 Å, below the nominal surface plane, would arrest further oxidation of more deeply-lying loose-packed copper crystallites. All measurements to date have been carried out under laboratory atmospheric conditions which do not allow satisfactory separation or control of the physical and chemical variables involved in the surface peculiarities. The method, under more controlled conditions of preparation and treatment of the surface, promises to be useful. (auth)

### 187

General Electric Research Lab.

ON THE QUESTION OF STRAIN ENERGY IN THE FORMATION OF SOLID SOLUTIONS. R. A. Oriani. Sept. 1954. 6p. Contract W-31-109-Eng-52. (SO-2035; RL-1175)

The strain-energy contribution to the enthalpy of formation of a solid solution is defined within the context of classical elasticity theory. This contribution is calculated for two solid solutions, taking into account the experimentally determined atom sizes in the solutions, and it is shown to be an almost negligible part of the total heat of solution. (auth)

### 188

General Electric Research Lab.

FUNDAMENTAL RESEARCH IN PHYSICAL METALLURGY. TWENTY-THIRD QUARTERLY REPORT. (PROGRESS REPORT NO. 40). J. H. Hollomon and D. Turnbull. Oct. 5, 1954. 9p. Contract W-31-109-Eng-52. (SO-2036; RL-1190)

It has been shown that the self-diffusion coefficient  $D$  of silver in grain boundaries described by the dislocation model is highly anisotropic in the sense that the diffusion coefficient is much higher in the boundary direction parallel to the dislocation line than in the perpendicular direction. It is very surprising that the anisotropy is quite marked in grain boundaries between crystals misoriented as much as  $\theta = 20^\circ$  around a [100] axis. However, there is very little anisotropy of  $D$  for  $\theta = 35^\circ$ . Measurements have been begun on the heats of solutions of liquid alloys for the purpose of checking the prediction of Lumsden and Wagner that for constant composition the difference in heat of solution between liquid and solid states equals the strain energy of solid solution. (For preceding period see SO-2034.) (auth)

### 189

General Electric Research Lab.

PREFERRED ORIENTATIONS IN BETA-ANNEALED ZIRCONIUM. J. H. Keeler and A. H. Geisler. Aug. 1954. 18p. Contract W-31-109-Eng-52. (SO-2516; RL-1148)

Preferred orientations in unalloyed zirconium and in a zirconium-niobium alloy were determined by the Geiger-counter spectrometer x-ray-diffraction technique. Annealing unalloyed zirconium in the  $\beta$  region just above the allotropic transformation temperature results in a reversion to the  $\alpha$ -annealing texture on cooling to room temperature. With higher  $\beta$ -annealing temperatures (through 1200°C), additional orientations predictable from the  $\alpha$ - $\beta$  orientation relationship were obtained. Evidence of a cube texture in  $\beta$  zirconium was observed on specimens annealed at 1400°C. The cubic zirconium-18% niobium alloy sheet was found to have textures very similar to those found in iron. No cube texture was observed in the alloy. Earlier work on cold-worked and  $\alpha$ -annealed zirconium was

reappraised to show a quantitative dependence of rotations on temperature and to identify spurious areas of some of the pole figures. (auth)

### 190

General Electric Research Lab.

DEVELOPMENT OF ZIRCONIUM-BASE ALLOYS.

TWENTIETH QUARTERLY REPORT. (PROGRESS REPORT NO. 21). J. H. Keeler. Oct. 5, 1954. 4p. Contract W-31-109-Eng-52. (SO-2517; RL-1191)

Metallographic and x-ray pinhole-pattern data showed that unalloyed zirconium sheets annealed at 400°C contained newly formed grains although the deformation-like texture was predominant. Creep-rupture data for some zirconium binary alloys are reported, the eight at.% aluminum alloy exhibiting the greatest strength at 500°C. The deformation texture of the zirconium-3 at.% tantalum alloy was found to be qualitatively similar to the deformation texture of unalloyed zirconium, whereas annealing at 900°C produced a texture somewhat similar to that obtained for unalloyed zirconium annealed at 1400°C. (For preceding period see SO-2515.) (auth)

### 191

Bjorksten Research Labs., Inc.

FOAMED METAL LOW DENSITY CORE MATERIAL FOR SANDWICH CONSTRUCTION. Johan Bjorksten, John C. Elliott, and Robert J. Roth. May 1954. 22p. Contract AF33(038)-21838. (WADC-TR-52-51(pt.3); AD-29436)

Research and development work proving the feasibility of foaming metals by means of a miscible gas former and progress in the design and construction of prototype equipment for the continuous production of low-density foams from aluminum-magnesium alloys are described. The most important innovations in the above phases of work performed are improved quality of foam through the introduction of air or oxygen into the foamed mixture prior to its solidification and the introduction of aluminum oxide-coated steel, a material with high corrosion resistance towards molten aluminum, magnesium, and their alloys, as a new structural material for certain components of the foaming equipment. Further improvement in quality and uniformity of product is seen to be largely contingent upon the construction of pilot plant equipment capable of providing a more truly continuous flow of foam in larger quantities. (auth)

### 192

Dow Chemical Co.

[PRINCIPLES OF THE EFFECT OF RARE-EARTH ADDITIONS ON THE HIGH TEMPERATURE PROPERTIES OF MAGNESIUM]. CREEP BEHAVIOR OF MAGNESIUM-CERIUM ALLOYS. June 1954. 39p. Contract AF(038)-16655, [Supplemental Agreement No. S2-(52-286)]. (WADC-TR-54-294)

Four binary alloys in this system were creep tested at 300 to 600°F. A photographic study of microstructural changes showed that the outstanding creep resistance results primarily from a potent precipitation hardening locally at grain boundaries. Twinning was correlated with the primary stage and nonbasal slip with the tertiary stage of creep. (auth)

### 193

TINNING AND SOLDERING OF ALUMINUM BY ULTRASONICS. P. Wenk and H. Boljahn. Translated from *Z. Metallkunde* 43, 322-4(1952). 7p. Available from Henry Brucher (Trans. No. 3231), Altadena, Calif. (AEC-tr-1963)



The design and performance of an ultrasonic apparatus for the tinning of Al is described. The effect of the duration of exposure to the ultrasonics on the bond between Al and Sn is discussed and illustrated. The corrosion behavior of the soldered joint is mentioned, and the methods of soldering some recommended types of joints are illustrated. (auth) **194**

INVESTIGATIONS INTO THE SPHEROIDIZING OF PLAIN CARBON AND LOW ALLOY STEELS. S. Ammareller. Translated from *Stahl u. Eisen* 70, 459-63(1950). 21p. Available from Henry Brucher (Trans. No. 3083), Altadena, Calif. (AEC-tr-1954)

A survey is made of the processes for spheroidize annealing of structural and tool steels to obtain good machinability and a suitable structure for the subsequent hardening. An investigation of the rate of the transformation of the carbides to spheroidal cementite during the spheroidize annealing of unalloyed and low alloy steels containing about 0.65 to 1.35% C, especially of roller bearing steel and unalloyed tool steels, is reported. The tests showed that, with the selection of a suitable annealing temperature, transformation to spheroidite occurs in a very short time. In the spheroidizing of hypereutectoid steels, the  $A_{c1}$  point can be exceeded to a fairly considerable degree. With markedly hypereutectoid steels, a new formation of (lamellar) pearlite occurs only at very high temperatures. With increasing annealing temperature, the as-annealed strength drops with simultaneous coarsening of the spheroidal cementite. The application of a short spheroidizing treatment, especially for hypereutectoid steels, is described. (auth)

**195**  
TECHNIQUE OF HIGH-VACUUM MELTING AND POURING. O. Winkler. Translated from *Stahl u. Eisen* 73, 1261-6, 1268(1953). 21p. Available from Henry Brucher (Trans. No. 3240), Altadena, Calif. (AEC-tr-1971)

The possibility of attaining vacua of less than 0.1 mm Hg by the use of more efficient diffusion pumps and improved sealing devices is discussed. Various types of high-vacuum melting installations (induction heated vs. resistance heated furnaces), requirements to be met, recommended refractories, contrivance for dependable addition of alloying metals in the proper sequence, how to prevent deposition of metal vapors on peephole window, and how to avoid discharges induced by vaporization of metals in conjunction with induced heating are discussed. Adequate melting and pouring techniques for charges weighing up to 1 ton and particulars on a high-vacuum induction melting plant are presented. The possibility of removing gases such as  $H_2$ ,  $O_2$ , and  $N_2$  dissolved in the steel or as reaction products is discussed. The vaporization of highly volatile alloying elements such as Mn and Cr, how to minimize it, and a way of avoiding excessive gas evolution at the start of steel heats are presented. The effects of vacuum melting of steel and the composition changes of a 1% C, 1.5% Cr bearing steel upon remelting in high vacuum are given. (J.A.G.)

**196**  
ON THE WELD CRACK SENSITIVITY OF LIGHT ALLOYS. (Ueber Die Schweißrissigkeit Von Leichtmetallen). H. Mäder. Translated from *Aluminium* 26, 30-2(1944). 5p. (TIB/T4224)

Reasons for the occurrence of weld crack sensitivity in light alloys and the effect of separation stresses, forms of

separation in the intermediate phases, micropipes, and unusual shrinking stresses are discussed. By using industrial alloy methods, it is shown how the causes peculiar to alloys, which may lead to cracking of the welding seam, can be avoided. In addition, hints are given on the avoidance of unusual shrinking stresses, and special attention is given to questions concerning design and heat techniques. Al-Mg and Al-Mg-Mn alloys are used as examples. (J.A.G.)

**197**  
REPRODUCIBILITY OF DIFFUSION MEASUREMENTS: TIME OF ANNEAL AND METHOD OF COUNTING RADIATION. C. T. Tomizuka and D. Lazarus (Univ. of Illinois, Urbana). *J. Appl. Phys.* 25, 1443(1954) Nov.

A re-examination of the self-diffusion in Ag near the melting point is reported. Both ends of single and coarse-grained crystal specimens (2-cm-diam. cylinders) of 99.99% purity were plated with high-specific-activity  $Ag^{110}$ . After annealing in vacuum at 903.5°C for 5, 24, and 110 hrs, independent determinations of the diffusion coefficient were made using material removed from each end of the specimen, employing  $\beta$  counting for one end and  $\gamma$  counting for the other. Within the precision of the experiment, the diffusion coefficient is independent of the time of anneal and the method of counting radiations. (L.M.T.)

**198**  
APPLICABILITY OF POWDER METALLURGY TO PROBLEMS OF HIGH TEMPERATURE MATERIALS. (With Discussion). G. M. Ault and G. C. Deutsch (Lewis Flight Propulsion Lab., NACA, Cleveland). *J. Metals* 6, 1214-30 (1954) Nov.

The efforts made to utilize powder metallurgy to solve problems encountered when using alloys at high temperatures are reviewed. The following subjects are discussed: comparison of wrought and sintered super alloys, sintered aluminum powder, porous materials for transpiration cooling, molybdenum, and cermet. (auth)

**199**  
A CALORIMETRIC INVESTIGATION OF HEATS OF FORMATION AND PRECIPITATION IN SOME Cu-Sn ALLOYS. J. B. Cohen, J. S. Ll. Leach, and M. B. Bever. *J. Metals* 6, 1257-8(1954) Nov.

Heats of formation of a Cu-rich Cu-Sn alpha solid solution and of  $Cu_3Sn$  epsilon phase were measured by Sn solution calorimetry. An approximate determination of the heat effect attending the precipitation of epsilon from a supersaturated alpha solid was made. (J.E.D.)

**200**  
DATA FOR ONE OF THE MARTENSITIC TRANSFORMATIONS IN AN 11 PCT Mo-Ti ALLOY. S. Weinig and E. S. Machlin (Columbia Univ., New York). *J. Metals* 6, 1280-1(1954) Nov.

The results of an experimental investigation of the habit orientation, lattice relations, and magnitude and direction of average transformation shear strain are presented. Orientations of subband markings for a single variant of the possible habit system in an 11% Mo-Ti alloy are given. (auth)

**201**  
MECHANICAL PROPERTIES OF ALPHA TITANIUM AS AFFECTED BY STRUCTURE AND COMPOSITION. R. I. Jaffee, F. C. Holden, and H. R. Ogden (Battelle Memorial Inst., Columbus, Ohio). *J. Metals* 6, 1282-90(1954) Nov.

The effects of grain size and shape on alloys of titanium

with nitrogen and aluminum have been determined. Increasing  $\alpha$  grain size decreases strength and hardness and increases impact resistance. Quenching from the  $\beta$  field produces subgrain markings delineating  $\alpha$  plates in Ti-N alloys but not in Ti-Al alloys. This suggests a precipitation from the high nitrogen alloys. (auth)

## 202

SOME OBSERVATIONS ON THE TERTIARY STAGE OF CREEP OF HIGH PURITY ALUMINUM. G. R. Wilms (Commonwealth of Australia Defense Standards Labs., Melbourne). *J. Metals* 6, 1291-6(1954) Nov.

A study has been made of the structural changes in polycrystalline high-purity aluminum during the tertiary stage of creep under conditions of constant tensile load. It appears that there is no basic modification in the particular mechanism of deformation that characterized the preceding secondary stage of creep but that the changes in crystalline structure produced during the tertiary stage are only a consequence and not a cause of the accelerated strain. Intercrystalline fissures were observed on entry into the tertiary stage, and these might supplement the accelerated rate of strain owing to local stress concentrations. There is evidence that the formation of these fissures may be associated with the presence of surface imperfections, and it is suggested that a more generalized treatment of the results may explain certain creep characteristics of commercial alloys. (auth)

## 203

THE INFLUENCE OF ANODIC OXIDE FILMS ON THE THERMAL OXIDATION OF ZIRCONIUM. J. J. Polling and A. Charlesby (Atomic Energy Research Establishment, Harwell, Berks, England). *Acta Met.* 2, 667-74(1954) Sept.

Changes in the thermal oxidation of zirconium due to the presence of an initial electrolytically formed oxide layer are studied. The increase in thickness of the oxide on heating is measured optically and gravimetrically. The effect of the initial layer is the same as if it had been produced thermally, i.e., there is no difference in the oxidation behavior of two specimens covered with initial oxide films of the same thickness, one of which has been grown electrolytically and the other thermally. The growth of the oxide layer is approximately logarithmic up to temperatures of about 260°C, cubic at 300°C, and at higher temperatures it tends towards a quadratic function of time. For thick films there is a linear law probably due to cracking of the oxide. These rates of growth are in agreement with theoretical calculations based on the oxidation theory of Mott. (auth)

## 204

RELAXATION EFFECTS IN SOLID SOLUTIONS ARISING FROM CHANGES IN LOCAL ORDER. I. EXPERIMENTAL. B. G. Childs and A. D. Le Claire (Atomic Energy Research Establishment, Harwell, Berks, England). *Acta Met.* 2, 718-26(1954) Sept.

Measurements are reported for various metallic substitutional solid solutions of the internal friction peaks which are believed to arise from changes in short-range order with stress. The solutions investigated were 5, 10, 15, 20, 25, and 30 at.% Cu-Zn, 15 at.% Cu-Al, and 20 at.% Pt-Ni. The theoretical significance of the two characteristic quantities of the peaks, the relaxation strength and the relaxation time, is discussed in terms of the degree of order, the atomic jump frequencies, and other relevant physical properties of the solutions. (auth)

## 205

ELECTRON DIFFRACTION STUDY ON THE ORDERED ALLOY CuAu. Shiro Ogawa and Denjiro Watanabe (Tohoku Univ., Honshu, Japan). *J. Chem. Soc. Japan* 9, 475-88(1954) Oct.

The ordered state in the gold-copper alloy of the atomic ratio 1 to 1 was investigated by electron diffraction with well orientated thin films. Below 340°C the pattern corresponded with a tetragonal superlattice the c axis of which is distributed into three original cubic axes. Above 360°C sharp crosses appeared at some of the positions of superlattice reflection, being accompanied with subsidiary maxima, and at the same time regularly spaced satellites arose around normal reflections, especially around the incident beam position. The former phenomenon could be clearly interpreted by antiphase domains which occur in the tetragonal superlattice and which lead to the orthorhombic CuAu II structure, and the latter which was first found by this experiment proved that a definite expansion of lattice appears periodically in each boundary of antiphase domains due to the asymmetrical distribution of gold and copper atoms at this place and to the tetragonality. Among the satellites around normal spots, only those around the direct spot are thought to be fundamental, and those around the other normal spots arise from the secondary elastic scattering peculiar to electron diffraction and are the mere repetitions of the fundamental satellites. Thus, the lattice of CuAu II possesses the inherent defect of lattice which has hitherto been overlooked. The transitional region between CuAu II and the cubic phase in the equilibrium diagram was also studied, the composition of films being varied in the vicinity of 1 to 1, and it was concluded that the two phases surely coexist as in case of CoPt. (auth)

## 206

SPHEROIDAL GRAPHITE FORMATION. E. Ward. *Metalurgia* 50, 155-8(1954) Oct.

A presentation is made of the more important facts and theories that have evolved concerning spheroidal graphite formation in cast iron in the as-cast state. (J.E.D.)

## 207

AN ESTIMATION OF SOME UNKNOWN SURFACE TENSION FOR METALS. J. W. Taylor (Atomic Energy Research Establishment, Harwell, Berks, England). *Metalurgia* 50, 161-5(1954) Oct.

The surface tensions of twenty-seven metals have been estimated in cases where experimental data is lacking. Fifteen correlations have been employed. Two of these, employing the relationship between the surface tension of a metal and its heat of vaporisation, yield surface tension values which are considered accurate to better than  $\pm 10\%$ . The remaining three correlations, while less exact, generally confirm the values thus deduced. The estimated values are substantiated by indirect experimental data. (auth)

## 208

U. S. AIR FORCE MACHINABILITY REPORT, 1954. INCREASED PRODUCTION, REDUCED COSTS THROUGH A BETTER UNDERSTANDING OF THE MACHINING PROCESS, AND CONTROL OF MATERIALS, TOOLS AND MACHINES. TITANIUM. Volume 3. James Van Voast. New York, Curtis-Wright Corporation, 1954. 153p. \$4.60

## 209

ZIRCONIUM. George Leslie Miller (Research Labs., Murex Ltd., Rainham, Essex, England). New York,



Academic Press Inc. and London, Butterworths Scientific Publications. 1954. 382p.

This book on Zr includes chapters on the history and occurrence, consumption and use, extraction from ore, separation from Hf, production, chemical, physical, and mechanical properties, fabrication, powder metallurgy, corrosion resistance, compounds, and alloys. (J.E.D.)

## 210

EFFECT OF POWER SUPPLY CHARACTERISTICS ON SIGMA WELDING. W. H. Helmbrecht and R. L. Hackman (Linde Air Products Co., Newark, N. J.). Welding J. (N. Y.) 33, 531-6(1954) June.

The development of a satisfactory power supply for sigma welding to provide optimum arc performance and simple control is reported. (auth)

## 211

PROCESS ADJUSTMENT IN INERT-GAS-SHIELDED ARC WELDING. Eugene B. LaVelle (General Electric Co., Richland, Wash.). Welding J. (N. Y.) 33, 553-60(1954) June.

It is possible to obtain statistical control of welding when applying the inert-gas-shielded welding process if the factors relating to process adjustment are properly considered. A list of questions for use in analyzing the specific application of the process is presented. Relative information follows each question as it appears. (auth)

## 212

CURRENT RECTIFICATION AND HIGH FREQUENCY INTERFERENCE IN INERT GAS WELDING. J. G. Murray. Welding J. (N. Y.) 33, 561-3(1954) June.

A lead acid storage battery offers a solution to the problem of overcoming the d-c component in rectified alternating current. A comparatively weak spark, introduced at the exact same instant in every alternating current cycle, was found to give good consistent inert arc welding over the entire range of the transformer without the problem of radio interference. (auth)

## 213

EXPLORATORY TESTS OF THE AIR-CARBON ARC CUTTING PROCESS. A. R. Hard (State Coll. of Washington, Pullman). Welding J. (N. Y.) 33, 261s-4s(1954) June.

Tests results which were made of the Arcair cutting process in mild and 304 stainless steels, using both plain and Cu-coated electrodes, are presented. Results indicate that the amount of C introduced should not be serious for many applications, the mild and 304 stainless steels showing satisfactory bend tests and ~0.04% average increase in C content. Some Cu pickup is observed when Cu-plated cutting electrodes are used, but is not thought to be serious. The process seems to hold considerable promise for removal of defective areas from metal parts and for back gouging of welds. (L.M.T.)

## 214

FATIGUE AS A FACTOR IN PRESSURE VESSEL DESIGN. T. J. Dolan (Univ. of Illinois, Urbana). Welding J. (N. Y.) 33, 265s-75s(1954) June.

The factors influencing the fatigue strength of metals are discussed from the viewpoint of their applicability to design of pressure vessels. (auth)

## 215

ALLOY WELDS DEPOSITED IN "UNALLOYED" TITANIUM BASE METAL: PART I. C. E. Harthower and Daniel M. Daley, Jr. (Watertown Arsenal Lab., Mass.). Welding J. (N. Y.) 33, 311s-26s(1954) July.

The development of a method for improving the toughness and strength of weld joints in unalloyed Ti is presented. The method consisted of depositing commercial Ti alloys in unalloyed base metal. By varying the joint design or energy impact in welding unalloyed Ti, it was possible to produce various compositions in the weld joint through the addition of commercial alloys as filler materials. The chemical composition of the weld deposit was determined and the performance of the various alloys evaluated by mechanical testing. An evaluation was made of the effect of C, O, H, and N on the properties and structure of the unalloyed and alloyed weld deposits. (J.E.D.)

## 216

WELDING PROCEDURE FOR WELDING TUBES IN HEAT EXCHANGERS. W. E. Battles (Leader Iron Works, Inc., Decatur, Ill.). Welding J. (N. Y.) 33, 739-42(1954) Aug.

An experimental assembly setup for the development of suitable procedures and specifications for fabricating tubular heat exchangers is presented. From the results of the experiment, a standard procedure was established which specifies that tube-to-tube sheet assemblies can best be made by first rolling, then welding without rerolling. (J.E.D.)

## 217

NEW PRINCIPLES FOR THE CALCULATION OF WELDED JOINTS. C. G. J. Vreedenburgh (Technological Univ. of Delft, Netherlands). Welding J. (N. Y.) 33, 743-51(1954) Aug.

For the calculation of the strength of welded joints, use has been made of a critical surface of the ultimately allowable values for the average stresses either in the smallest longitudinal section (throat section) or cross section of the weld. In statically loaded structures the shape of the critical limit curve for loads perpendicular to the longitudinal axis of the weld can be deduced from the experiments. As the shape of the surface of limits, a surface of revolution (pearoid) has been assumed, of which the meridian section forms the limit curve. In comparison with Kist's method of calculation, the principles here presented allow not only some simplification but above all economy in the case of weld sections predominantly loaded in shearing or compression. In dynamically loaded structures a symmetrical surface of revolution has been adopted as the shape of the critical surface of allowable effective stresses. This effective stress is to be obtained by multiplying the numerically greatest value of the oscillating stress by a coefficient  $\gamma$ , which is coherent with the fatigue diagram of the material and the type of weld. The values of  $\gamma$  are given both for butt and fillet welds for two frequency ranges of load oscillations. (auth)

## 218

SUBMERGED ARC WELDING OF CHROMIUM-BEARING STEELS. Clarence E. Jackson and Arthur E. Shrubbsall (Linde Air Products Co., Niagara Falls, N. Y.). Welding J. (N. Y.) 33, 752-8(1954) Aug.

In the submerged arc welding of chromium-bearing steels, many of the relationships of welding technique to weld performance which have been suggested for mild steels generally apply. The chromium content of a six-pass weld deposit is 80% that of the electrode when using Unionmelt Grade 80 welding composition and it is 80% that of the electrode plus 1.25% when using Unionmelt Grade 88 welding composition. At a given chromium level, lower silicon content of weld metal is obtained when using Grade 88 than with

Grade 80 welding composition. The use of these relationships should aid in improving the control of weld metal analyses in the submerged arc welding of chromium-bearing steels. (auth)

219

SPOT WELDING THIN ALUMINUM. I. W. Johnson (General Electric Co., Schenectady, N. Y.). Welding J. (N. Y.) 33, 759-62(1954) Aug.

Slope control with single-phase equipment provides the means of simulating the wave shape of stored energy discharge necessary for welding thin Al alloy sheets. (auth)

220

THE EFFECT OF WELDING VARIABLES ON HARD-FACING DEPOSITS. A. Zvanut and V. Peters (Lincoln Electric Co., Cleveland, Ohio). Welding J. (N. Y.) 33, 778-82(1954) Aug.

Hard-facing of alloy steels with the electric arc, a process for simultaneously alloying and heat treating, is affected by welding variables and cooling rate. This paper, through analysis of laboratory test data, indicates areas and directions controls should take. (L.M.T.)

221

WELDING ALUMINUM SHEET. F. C. Geibig (Linde Air Products Co.). Welding J. (N. Y.) 33, 784-8(1954) Aug.

222

THE WELDING OF HEAVY SECTIONS. W. Spraragen (Welding Research Council, New York) and M. A. Cordovi (Babcock and Wilcox Co., New York). Welding J. (N. Y.) 33, 369s-86s(1954) Aug.

Preheating, peening, intermediate stress relieving, special electrodes, and special techniques are reported as some of the devices used in welding heavy sections 3 in. and over. (auth)

223

EFFECTS OF TEMPERATURE ON WELD METAL PROPERTIES. J. Heuschkel (Westinghouse Research Labs., East Pittsburgh, Penna.). Welding J. (N. Y.) 33, 388s-97s(1954) Aug.

A study was made of the tensile properties of arc-deposited C-steel weld metal in uniformly loaded specimens across the temperature range from -300 to +1400° F in both the as-deposited and stress-relief annealed conditions. (auth)

224

THE SPOT WELDING OF TITANIUM. E. R. Funk (Good-year Aircraft Corp., Akron, Ohio). Welding J. (N. Y.) 33, 397s-400s(1954) Aug.

A study was made of the physical properties of Ti spot welds using different settings and thicknesses of materials. (auth)

225

ALLOY WELDS DEPOSITED IN "UNALLOYED" TITANIUM BASE METAL. PART II. C. E. Hartbower and Daniel M. Daley, Jr. (Watertown Arsenal Labs., Mass.). Welding J. (N. Y.) 33, 401s-14s(1954) Aug.

A study was made of a method of improving the toughness and strength of weld joints in unalloyed Ti. It was found that when the C, O, H, and N of the base metal is high relative to that of the filler metal, the base metal contributes to the contamination of the weld deposit. Hardness, bend, tensile, and impact tests all show the effect of base metal C, O, H,

and N on the performance of deposited weld metal. Alpha-beta structures, produced by the presence of small amounts of beta-stabilizing elements are more notch-tough than the all-alpha structures of unalloyed Ti. (J.E.D.)

226

EFFECTS OF OXYGEN AND NITROGEN IN WELDING TITANIUM ALLOYS. James H. Johnston (Mallory-Sharon Titanium Corp., Niles, Ohio). Welding J. (N. Y.) 33, 414s-16s(1954) Aug.

A study was made of the maximum tolerable O and N contamination levels in welds in alloys of Ti as determined through simulated welds of these alloys. (auth)

227

WELDMENTS IN THE TITANIUM-MANGANESE SHEET ALLOY RC-130A. H. M. Meyer (Armour Research Foundation, Chicago, Ill.). Welding J. (N. Y.) 33, 417s-21s(1954) Aug.

The commercial titanium sheet alloy RC-130A contains approximately 6.5 to 8% manganese and is known to embrittle after welding. The phase relationships of the titanium-rich end of the binary titanium manganese system are discussed with a view to the structural changes which occur in the various zones of an inert-arc, tungsten-electrode arc weld in sheet of  $\frac{1}{16}$  in. thickness. The occurring transformation structures, such as retained and brittle  $\beta$ , coarse and irresolvable  $\alpha$ , are consistent with those observed in the other eutectoid type titanium systems. The significance of particular microstructures in the weldment are discussed as indicative of physical properties. It is also shown that this important relationship enables us to restore to the weldment the ductility of the unwelded sheet by appropriate heat treatments. Two types, the solution treatment followed by an isothermal anneal, and the simple  $\alpha + \beta$  treatment, are shown to be suitable. Finally, the effects of surface contamination and of variation in manganese content on the transformation structure are demonstrated. (auth)

228

30-FT DIAMETER ALL-WELDED TEST TANK. John Vast and Frank W. Dunham (U. S. Navy Dept., Bureau of Ships, Washington, D. C.). Welding J. (N. Y.) 33, 422s-32s(1954) Aug.

Some unique problems encountered in the design and construction of a 30-ft diameter all-welded steel test tank are described. The theoretical solutions to some of these problems are given, and compared with experimental data taken during the proof testing of the tank. (auth)

229

LIQUID METALS. PART I. THE SURFACE TENSION OF LIQUID SODIUM: THE VERTICAL-PLATE TECHNIQUE. C. C. Addison, D. H. Kerridge, and J. Lewis (Nottingham Univ., Nottinghamshire, England). J. Chem. Soc., 2861-6(1954) Aug.

This paper describes the determination of the surface tension of liquid Na in an atmosphere of pure argon, from measurements on plates of Zn, Cu, and Mo suspended, and partly immersed, in liquid Na. In the temperature range 100-100° Zn can be fully wetted by Na, but Cu and Mo are not wetted; the technique employed for contact angles of 0° and 180° is described. The surface tension is found to be 195 dynes/cm. at the melting point, and the temperature coefficient is 0.1 dyne/cm./degree. (auth)



## PHYSICS

## 230

Atomic Energy Research Establishment, Harwell, Berks (England)

ELECTROLYTIC CURRENT FLOW BY BUBBLE MIGRATION. O. Flint. July 6, 1954. 20p. (AERE-M/R-1470)

The anodic oxidation of tantalum in various ethylene glycol electrolytes containing common acid radicals shows a complex relationship between potential and time at constant current density. The departure from a rectilinear relationship which obtains in aqueous media, is shown to be due to the migration between the electrodes of electrolytic bubbles carrying with them liquid of high and low pH created at the electrode surfaces, other controllable variables having little significant effect. (auth)

## 231

Solid-State and Molecular Theory Group, Mass. Inst. of Tech.

QUARTERLY PROGRESS REPORT NO. 14. Oct. 15, 1954. 51p. Contract N5ori-07856. (NP-5362)

A density of state curve for Ni has been obtained by a tight-binding calculation and shows a dip in the middle of the 3d band similar to previously reported results. Satisfactory convergence has been found in augmented plane wave solutions of the periodic potential problem in Cu. The APW method is presently being applied to the energy band structure of KCl. Many of the problems discussed in this and preceding progress reports have been solved by application of the Whirlwind computer, and a summary of particular techniques employed for the solid state program is presented. Preliminary results on the limited configuration interaction treatment of  $\text{NH}_3$  and the revised valence bond treatment of  $\text{H}_2\text{O}$  are reported. (For preceding period see NP-5309.) (K.S.)

## 232

Carnegie Inst. of Tech.

LUMINESCENT EFFICIENCY OF LARGE CRYSTALS OF  $\text{CaWO}_4$  AND  $\text{CdWO}_4$ . FINAL REPORT [FOR] PERIOD JANUARY 1, 1951 TO JUNE 30, 1952. Paul W. Levy. 91p. Contract Nonr-230(00). (NP-5367)

The problem of determining the luminescent efficiency of phosphors in the form of powders and large single crystals is considered. A method applicable to large single crystals has been developed and applied to crystals of synthetic  $\text{CaWO}_4$  and  $\text{CdWO}_4$ . As an adjunct to the efficiency measurements the luminescent spectra of these materials was measured at liquid  $\text{N}_2$ , dry ice, and room temperatures. Also, their reflection of 2537 Å ultraviolet and optical transmission from 2100 to 8000 Å is given for room temperature. The room-temperature quantum efficiencies of two different crystals of  $\text{CaWO}_4$  are 0.74 and 0.82, in agreement with published values for the efficiency of powders. Due to large uncertainties in the indices of refraction, the efficiencies obtained for two crystals of  $\text{CdWO}_4$ , 1.0 and 1.2, values that are probably too large, must be considered unreliable. (auth)

## 233

Technical Information Service, AEC

PHOTOGRAPHIC TECHNIQUES AND EQUIPMENT. A SELECTED LIST OF UNCLASSIFIED AEC REPORTS.

Robert E. Allen, comp. July 1954. 27p. (TID-3058)

The utilization of photographic emulsions, techniques, and

equipment in research work conducted under AEC contract is reported. A total of 142 selected references are included in this annotated bibliography. (auth)

## 234

Naval Radiological Defense Lab.

THE PRODUCTION OF INTENSE BEAMS OF THERMAL RADIATION BY MEANS OF A HIGH CURRENT CARBON ARC AND RELAY-CONDENSER OPTICAL SYSTEM. T. R. Broida. Nov. 24, 1953. 42p. (USNRDL-417; AFSWP-480)

A source of intense thermal radiation, utilizing a high-current carbon arc and a relay condenser lens system, has been developed. This source was developed primarily for the investigation of the effect of thermal radiation on materials. The source will provide maximum irradiance levels of 16, 23, and 30 cal/sq cm/sec over circular areas of 10, 5, and 3 sq cm, respectively, using 3 lens combinations. The spatial and temporal distribution of the irradiance level within the circular areas can be made uniform within  $\pm 5$  per cent during normal operation of the source. The spectral distribution of the thermal radiation at the exposure planes was found to be similar to that radiated by a black body at 6000 deg K with the exception of the near ultraviolet region of the spectrum where the arc radiation is absorbed by the glass in the optical system. (auth)

## 235

Naval Research Lab., Univ. of Wis.

THE OPTIMUM FREE VOLUME THEORY OF LIQUIDS. John S. Dahler and Joseph O. Hirschfelder. Oct. 15, 1954. 13p. Contract N7onr-28511. (WIS-ONR-12)

An iterative method for solving Kirkwood's integral equation for the free volume of a liquid is described. This procedure uses the results of the well known Lennard-Jones and Devonshire theory of liquids as its starting point. The results of the calculations suggested would provide a good test of the validity of the cell theory of liquids. It is believed that this optimum free-volume theory will remove several of the undesirable characteristics of the Lennard-Jones and Devonshire liquid. (auth)

## 236

CONCERNING CAPILLARY CONDUCTION OF WATER IN THE GROUND (RISE, SEEPAGE AND APPLICATION TO IRRIGATION). Josef Kozeny. Translated by—Elsasser from Sitzber. Akad. Wiss. Wien. Mathnaturw. Kl. 136, (Abt. IIa), 271-306(1927). 44p. (AEC-tr-1961)

## 237

THE SPECIFIC HEAT OF SOLID BODIES. G. Leibfried and W. Brenig. Translated from Z. Physik 134, 451-68(1953). 14p. (AERE-Trans-11/3/5/430)

## 238

THERMODYNAMIC ANALYSIS OF IRREVERSIBLE LOW-TEMPERATURE PROCESSES. 1. THEORY AND FUNDAMENTALS OF A GENERALIZED METHOD OF ANALYSIS. (Termodinamicheski analiz neobratimyykh nizkoterturnyykh protsessov. 1. Teoreticheskie polozheniya i osnovy obobshchennogo metoda analiza). I. P. Ishkin and V. M. Brodianski. Translated by G. Belkov from Zhur. Tekh. Fiz. 22, 1773-82(1952). 15p. (TT-475)

The analysis of low-temperature processes based on the first thermodynamic principle does not give a complete picture of the physical nature of the processes. The use of the second thermodynamic principle makes it possible to evaluate quantitatively the irreversibility of the entire

process or of any part by accounting for heat potential. A generalized method of analyzing low-temperature processes has been developed for which the concept of the degree of astaticism in partially reversible processes is introduced. Concepts of the coefficient of thermodynamic reversibility (ctr) and the coefficient of thermodynamic astaticism (cta) are introduced. A comparison of ctr and cta is given. A classification of the processes from the point of view of their thermodynamic analysis on the basis of irreversibility is given. A diagram is developed which permits a convenient thermodynamic calculation connected with the analysis of irreversibility. (auth)

## 239

THE SOLUBILITY OF GASES IN LIQUIDS AT LOW TEMPERATURES AND HIGH PRESSURES. 1. THE SOLUBILITY OF HYDROGEN IN LIQUID NITROGEN AT TEMPERATURES OF 79.0–109.0°K AND PRESSURES UP TO 190 ATM. (Die Löslichkeit von Gasen in Flüssigkeiten bei niedrigen Temperaturen und hohen Drucken. 1. Die Löslichkeit von Wasserstoff in flüssigem Stickstoff bei Temperaturen von 79.0–109.0°K und Drucken bis zu 190 atm). M. G. Gonikberg, W. G. Fastowsky, and J. G. Gurwitsch. Translated by D. J. Wright from *Acta Physicochim. U.R.S.S.* 11, 865–82(1939). 21p. (TT-478)

An apparatus for the investigation of liquid-vapor equilibria using the circulation method is described. The solubility of hydrogen in liquid nitrogen at temperatures of 79.0, 86.1, 95.4, and 109.0°K and pressures up to 190 atm. and the hydrogen content in the gas phase at these temperatures and pressures were determined. It was shown that at 79.0 to 109°K the binary hydrogen–nitrogen system, taking the entire pressure interval into consideration, does not follow the laws of dilute solutions. In certain pressure intervals which depend on the temperatures, the hydrogen–nitrogen system can be regarded as a system which follows the thermodynamic equations for dilute solutions. Thus negative values for the partial molar volumes of the hydrogen were obtained. Equations are suggested for the relationship between solubility of hydrogen in nitrogen and the temperature and pressure in the pressure and temperature interval under consideration, for the relationship between the hydrogen concentrations in the gas and liquid phases and the pressure (for solubilities of hydrogen not over 20 to 22%), and for the relationship between the maximum value of the  $p-x$  curve and the temperature. (auth)

## 240

THE SOLUBILITY OF GASES IN LIQUIDS AT LOW TEMPERATURES AND HIGH PRESSURES. 2. THE SOLUBILITY OF HELIUM IN LIQUID NITROGEN AT TEMPERATURES BETWEEN 78.0 AND 109.0°K AND PRESSURES UP TO 295 ATM. (Die Löslichkeit von Gasen in Flüssigkeiten bei niedrigen Temperaturen und hohen Drucken. 2. Die Löslichkeit von Helium in flüssigem Stickstoff bei Temperaturen von 78.0 bis 109.0°K und Drucken bis zu 295 atm). M. G. Gonikberg and W. G. Fastowsky. Translated by D. J. Wright from *Acta Physicochim. U.R.S.S.* 12, 67–72(1940). 8p. (TT-479)

The solubility of He in liquid N was determined at 78, 90.1, and 109°K and pressures up to 295 atm. using the circulation method. The He content in the vapor phase generally exceeded 60 to 70%. It was shown that at temperatures from 78 to 109°K and between 50 and 300 atm., the binary He–N system follows the law of ideal solutions. The values of the Henry's law constants and the partial

molar volumes of dissolved He were calculated at the above temperatures. (J.A.G.)

## 241

THE SOLUBILITY OF GASES IN LIQUIDS AT LOW TEMPERATURES AND HIGH PRESSURES. 3. THE SOLUBILITY OF HYDROGEN IN LIQUID METHANE. (Die Löslichkeit von Gasen in Flüssigkeiten bei niedrigen Temperaturen und hohen Drucken. 3. Die Löslichkeit von Wasserstoff in flüssigem Methan). W. Fastowsky and M. Gonikberg. Translated by Dorothy J. Wright from *Acta Physicochim. U.R.S.S.* 12, 485–8(1940). 7p. (TT-480)

The solubility of hydrogen in liquid methane and in vapor phase was determined at 90.3, 110.0, 122.0, and 127.0°K and at pressures from 180 to 230 atm. It was shown that, at 90.3 to 127.0°K and the pressures studied, the binary system  $H_2-CH_4$  follows Kritschewsky's equation of dilute solutions. The values of the Henry's law constants and the partial molar volumes of dissolved hydrogen at temperatures of 90.3, 110.0 and 127.0°K were calculated. (auth)

## 242

THE PREPARATION OF THIN TARGETS OF CARBON AND OXYGEN. H. D. Holmgren, J. M. Blair, K. F. Famularo, T. F. Stratton, and R. V. Stuart (Univ. of Minnesota, Minneapolis). *Rev. Sci. Instr.* 25, 1026–7(1954) Oct.

Methyl iodide has been successfully cracked onto Ni backings to form thin self-supporting C targets. A successful method of heating the foil was to focus light from a 1000-w lamp through the glass wall of the vacuum chamber onto the foil surface. With the  $CH_3I$  vapor at a pressure of 10 cm Hg, a uniform layer, 1 cm. in diam., containing  $5 \times 10^{18}$  C atoms/cm<sup>2</sup> could be deposited in a min. Thin targets of NiO were prepared by the oxidation of Ni when the Ni foil was heated in a similar manner in  $O_2$ . With  $O_2$  pressures of 1 to 15 cm Hg, NiO targets ranging in thickness from  $4 \times 10^{-8}$  to  $1 \times 10^{-4}$  in. and containing  $1 \times 10^{18}$  to  $25 \times 10^{18}$  O atoms/cm<sup>2</sup> were obtained. (L.M.T.)

## 243

SOME PROPERTIES OF SOLUTIONS OF  $He^3$  AND  $He^4$ . III. VAPOR TENSION. B. N. Esel'son. *Zhur. Eksptl.'1 Teoret. Fiz.* 26, 745–50(1954) June. (In Russian)

The vapor pressure of solutions of  $He^3$  and  $He^4$  was measured with the object of establishing the equilibrium between the liquid and vapor. The data, obtained for solutions with 0.49, 1.00, 2.40, 4.23, 5.18, and 8.08% of  $He^3$  establishes the nonideal behavior of such solutions. (tr-auth)

## 244

DIFFUSION OF HYDROGEN AND DEUTERIUM IN HIGH PURITY ZIRCONIUM. Earl A. Gulbransen and Kenneth F. Andrew (Westinghouse Research Labs., East Pittsburgh, Penna.). *J. Electrochem. Soc.* 101, 560–6(1954) Nov.

Kinetics of the reaction of zirconium with pure hydrogen and deuterium was studied for 60° to 250°C,  $H_2$  pressures of 1.1 to 5.0 cm Hg, and composition range Zr to  $ZrH_{1.70}$ , using a vacuum microbalance method. The reaction was shown to be diffusion controlled with diffusion occurring from a surface of constant concentration into a heterogeneous system. The diffusion equation was solved for these conditions using the method originally developed by Neuman and recently applied by Wagner to this type of problem. Average concentration according to this view is given by  $\bar{C} = 2.845 D^{1/2} t^{1/2} / h$ , where D is diffusion coefficient in cm<sup>2</sup>/



sec,  $t$  is time in seconds, and  $h$  is specimen thickness in centimeters. Plots of  $\bar{C}$  vs.  $t^{1/2}$  show this relationship to hold over wide variations in time, temperature, pressure, and specimen thickness. Diffusion coefficients were calculated and when plotted against  $1/T$  on a logarithmic plot gave a heat of activation of 11,400 cal/mole. The corresponding entropy of activation was 2.7 cal/mole/°C. The following equation expresses data for diffusion of hydrogen in zirconium:  $D = 1.09 \times 10^{-3} \exp(-11,400/RT)$  cm<sup>2</sup>/sec. For the composition range of Zr to ZrH<sub>1.6</sub>, experimental data fit the proposed explanation for the reaction. At higher compositions, deviations were observed. Diffusion of deuterium in zirconium was also studied and data found to fit the equation  $D_{D_2} = 0.73 \times 10^{-3} \exp(-11,400/RT)$  cm<sup>2</sup>/sec. The relationship between the diffusion coefficient of hydrogen and deuterium was found to be 1.5. The theoretical value should be  $\sqrt{2}$ . The diffusion mechanism proposed was verified by experimental results. (auth)

## 245

ALIGNMENT OF SODIUM ATOMS. W. B. Hawkins (Palmer Physical Lab., Princeton, N. J.). Phys. Rev. **96**, 532-3(1954) Oct. 15.

The author in an earlier article (Phys. Rev. **91**, 1008 (1953)) reported the polarization of Na atoms by the absorption of circularly polarized resonance radiation. This note reports and discusses the partial alignment of Na atoms induced by the scattering of unpolarized photons. Because of the definite direction of incidence, the unpolarized photons possess some order, and the scattering induces alignment along the axis of the incident light. (L.M.T.)

## 246

CATALOGUE OF RADIOACTIVE MATERIALS. Amersham, Bucks., England, Radiochemical Centre. June 1953. 15p.

This catalog includes pertinent description and price list of radioactive materials available from the Radiochemical Centre, including labeled compounds, processed radioisotopes, natural radioelements, and  $\alpha$ ,  $\beta$ ,  $\gamma$  and neutron sources. (J.E.D.)

## 247

A METHOD OF EXAMINING SELECTED AREAS OF SURFACES USING REPLICAS AND THE ELECTRON MICROSCOPE. G. R. Booker (Metropolitan-Vickers Electrical Co., Ltd., Manchester, England). Brit. J. Appl. Phys. **5**, 349-50(1954) Oct.

A simple method has been devised for examining selected areas of surfaces using wet-stripped replicas. The selected area of the surface is identified by fine scratches in the immediate vicinity. The corresponding portion of a replica is mounted over a 0.015-in.-diameter hole in a copper disk and viewed in an electron microscope operating with a specimen screening aperture. The method has several advantages over methods hitherto used, e.g., it has extremely wide application as it does not depend on surface structure for identification, the positioning of the replica on the copper disk is rapid and can be correctly performed each time, and an uninterrupted area of 0.015 in. diameter can be observed. (auth)

## 248

THE QUENCHING OF POTASSIUM RESONANCE RADIATION BY HYDROGEN AND DEUTERIUM. W. M. Smith, J. A. Stewart, and G. W. Taylor (Queen's Univ., Kingston, Ontario, Canada). Can. J. Chem. **32**, 961-8(1954) Oct.

The quenching of the resonance radiation of potassium

by hydrogen and deuterium has been studied over the temperature range 71 to 83°C. The quenching cross sections at 76°C were found to be  $1.56 \times 10^{-16}$  cm<sup>2</sup> and  $1.10 \times 10^{-16}$  cm<sup>2</sup>, respectively. (auth)

## 249

THREE-QUANTUM ANNIHILATION OF POSITRONS IN SOLIDS. R. L. Graham and A. T. Stewart (Atomic Energy of Canada Ltd., Chalk River, Ontario). Can. J. Phys. **32**, 678-9(1954) Oct.

Measurements of the number of three-quantum decays in various substances are reported. These materials include Li, Be, Al, Cu, Au, Pb, U, urea, rubber, crystalline quartz, fused quartz, polystyrene, and Teflon. (L.T.W.)

## 250

ELECTRON EMISSION FROM METALS UNDER HIGH-ENERGY HYDROGEN ION BOMBARDMENT. B. Aarset, R. W. Cloud, and J. G. Trump (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys. **25**, 1365-8(1954) Nov.

Measurements of the electron emission from Mg, Al, Fe, Ni, Au, and Pb surfaces bombarded by atomic ( $H_1^+$ ) and molecular ( $H_2^+$ ) hydrogen ions with energies from 0.7 to 2.0 Mev showed a diminishing emission with ion energy and little dependence on either atomic number or on the field intensity at the metal surface. Measurements of this type are of interest in connection with the mechanism of high voltage discharge in vacuum. The expected variation of secondary emission with angle of incidence and with conditioning was found. The emission ratios are compared with measurements by others at lower ion energies. (auth)

## 251

RADIOACTIVE AND PHOTOELECTRIC p-n JUNCTION POWER SOURCES. W. G. Pfann and W. van Roosbroeck (Bell Telephone Labs., Murray Hill, N. J.). J. Appl. Phys. **25**, 1422-34(1954) Nov.

An electrical power source can be made by exposing a p-n junction to radioactivity or light, so that the junction field separates electron-hole pairs produced by the radiation. Expressions for maximum power, optimum load resistance, and efficiency are derived from an equivalent circuit and rectification theory. Power and efficiency increase with source current  $I_g$  of separated charges and zero-bias junction resistance.  $I_g$  increases with energy and intensity of radiation, but is limited by self-absorption in the radioactive isotopes. Estimates of attainable power and efficiency for silicon cells are  $3 \cdot 10^{-3}$  watt cm<sup>-2</sup> and 15% for solar radiation, averaged, allowing for night, weather, and varying angle of incidence; and  $3 \cdot 10^{-4}$  watt cm<sup>-2</sup> and 8% for beta radiation from  $Sr^{90}$ - $Y^{90}$  of activity 32 c/g. However, lattice defects produced by  $Sr^{90}$ - $Y^{90}$  beta radiation impair cell performance by increasing electron-hole recombination. A theoretical estimate of threshold energy for radiation damage in silicon is about 0.3 Mev, about half the experimental value reported for germanium. Avoiding radiation damage by annealing, by absorbers, and by use of less energetic isotopes is discussed. The  $Y^{90}$  beta spectrum is given; it is used in estimating damage rates in germanium, which are high, and efficiencies obtainable with absorbers, which are low. Theory and experiment are compared for  $Sr^{90}$ - $Y^{90}$  cells of silicon and of germanium. (auth)

## 252

ELECTRON TRAP DISTRIBUTIONS IN PHOSPHORS. J. M. Honig (Purdue Univ., Lafayette, Ind.). J. Chem. Phys. **22**, 1689-92(1954) Oct.

The possible interpretation of long lifetime phospho-

rescence decay in terms of the electron trap mechanism is briefly reviewed. It is then shown how the distribution of activation energies among filled traps may be computed from the experimentally observed decay curves. The decay curves can be expressed as a Laplace transform of the distribution density function for activation energies, and the latter can then be calculated by inversion of the transform. Several examples are given in illustration of the procedure. The limitations inherent in the procedure are briefly discussed, and it is pointed out how the method might be used to test the applicability of the simple electron-trap model to experimental data. (auth)

## AEROSOLS

### 253

THE PHYSICS OF PARTICLE SIZE ANALYSIS. A CONFERENCE ARRANGED BY INSTITUTE OF PHYSICS AT UNIV. OF NOTTINGHAM, ENGLAND, 6-9 APRIL, 1954. *Brit. J. Appl. Phys. Suppl. No. 3*, 1954. 223p.

A group of 31 papers dealing with varied aspects of particle size measuring techniques is presented. Particles of very small size, such as those encountered in industrial processes, are considered. Papers on the relative motion of particles and fluids are included. Light scattering and absorption and particle shape factors are studied in relation to visual and automatic counting and sizing methods. (K.S.)

## COSMIC RADIATION

### 254

Minnesota Univ.  
MEASUREMENT OF MULTIPLY CHARGED COSMIC-RAYS BY A NEW TECHNIQUE. John Linsley. Aug. 1954. 46p. Contract N6onr-246. (NP-5358)

The Čerenkov effect has been applied to the problem of determining the charge of cosmic-rays. Cloud chamber photographs have been obtained of the events that caused large signals from a thin Čerenkov counter during a balloon flight which carried the apparatus above most of the atmosphere. They show that the Čerenkov counter was notably effective at discriminating against the background effects that plague counter measurements on the charge spectrum of cosmic-rays, for a relatively large proportion of the signals were caused by single heavily ionizing particles. The theory of the Čerenkov effect associates a lower velocity limit with the signal amplitude requirement that those particles met. Their ionization was determined well enough to classify particles of such velocity as having  $Z = 2$  or  $Z > 2$  with considerable certainty. The vertical flux of doubly charged particles with kinetic energy  $> (610 \pm 100)$  Mev/nucleon beneath 17 gm/cm<sup>2</sup> of atmosphere and 13 gm/cm<sup>2</sup> of local matter is found to be  $(79 \pm 11)/\text{m}^2\text{-sec-steradian}$ . That result and currently accepted assumptions concerning absorption imply the value  $(135 \pm 20)/\text{m}^2\text{-sec-steradian}$  for the extrapolated vertical flux of primary alpha-particles with energy above  $(670 \pm 100)$  Mev/nucleon. Some of the alpha-particles were seen to interact in copper plates within the cloud chamber. The observations indicate that the collision mean free path is  $(100 \pm 25)$  gm/cm<sup>2</sup>. The problem of counter measurements on components heavier than helium is scrutinized. (auth)

### 255

Minnesota Univ.  
ČERENKOV COUNTER MEASUREMENT OF COSMIC RAY

ALPHA PARTICLES AT 41°. Nahmin Horwitz. Aug. 1954. 78p. Contract N6onr-246. (NP-5359)

A Čerenkov counter was flown by balloon to a height of 16 gm/cm<sup>2</sup> on February 2, 1954, at a geomagnetic latitude of 41° 21'. The purpose of the experiment was to measure the  $\alpha$  particle flux and to observe the behavior of a Čerenkov counter in the  $3 \leq Z \leq 9$  region. A Čerenkov counter was used because of its inherent discrimination against slow particles. Guard counters were included to identify background events due to side showers. Crossed trays of Geiger counters were used to identify background events in which a proton interacted in the radiator, producing a number of charged secondaries. The equipment was at altitude for 355.5 minutes. The pulse height distribution for all events showed a partially resolved  $\alpha$  peak. A total of 3024 events occurred which gave pulse heights corresponding to  $\alpha$  particles. In 451 of these cases a guard counter was fired simultaneously. These are all classed as background. In 898 of the cases two or more Geiger counters in one of the crossed trays were fired simultaneously. Out of the 898 there is evidence that 247 represent true alphas which either 1) interacted in matter beneath the radiator, 2) produced a delta ray which triggered a second Geiger counter, or 3) passed obliquely through two adjacent Geiger counters. The remaining 651 are classed as background due to proton-induced nuclear interactions. It is estimated that an additional 478 events were due to background that the other two devices did not detect. (auth)

### 256

SPECTRA OF  $\pi$  and  $\mu$  MESONS IN COSMIC RADIATION. G. M. Garibyan and I. I. Gol'dman. *Zhur. Eksptl. i Teoret. Fiz.* 26, 258-63(1954) Mar. (In Russian)

On the basis of an analysis of the  $\mu$ -meson spectrum, the air spectrum generated by  $\pi$  mesons was calculated. (tr-auth)

### 257

CYCLE OF WORLD-WIDE CHANGES IN THE DAILY VARIATION OF MESON INTENSITY. V. Sarabhai, U. D. Desai, and D. Venkatesan (Physical Research Lab., Ahmedabad, India). *Phys. Rev.* 96, 469-70(1954) Oct. 15.

The study by Sarabhai and Kane of the world-wide changes in the daily variation of meson intensity has been extended by an analysis of unpublished Carnegie Institution data, kindly supplied by Dr. Forbush. Comparison of Carnegie Institution measurements at Huancayo and Cheltenham for the period 1937 to 1952 reveals high correlation between changes of the times of maxima at the two stations. The changes of amplitudes of the daily variations are not equally consistently related. The change of intensity of the coronal 5303A emission line exhibits the major features seen in the change of the daily variation of meson intensity. Both follow the usual 11-year solar cycle of activity. (auth)

### 258

GEOMAGNETIC EFFECTS OF THE  $\mu$  MESON COMPONENT OF COSMIC RADIATION AT SEA LEVEL. I. F. Quercia and B. Rispoli (Istituto di Fisica dell' Università, Rome, Italy). *Nuovo cimento* (9) 12, 490-518(1954) Oct. (In English)

In order to investigate the processes of creation of mesons by primary radiation and the hypothetical presence of negative particles in the primary radiation, two experiments have been carried out at high latitude (Rome, 42°) and



low latitude (Bombay, 9°): 1) "charge excess experiment"; 2) "absorption spectrum experiment" under water and in the open air. The east-west asymmetry, the latitude effect, and the charge excess have been studied as a function of zenithal angle. Some of the conclusions are the following: a) the measured negative excess in the eastern direction can be explained without introducing the hypothesis of negative primary particles; b) the energy dependence of the positive excess is not in contradiction with Heitler's theory; c) the latitude effect is about 15% in the vertical direction for mesons of energy greater than 0.5 bev and seems to increase in the eastern direction, and to decrease in the western direction with increase of zenithal angle; d) the ratio between the energy of the created mesons and the energy of the protons is of the order of 0.2. (auth)

## 259

A CLOUD CHAMBER ANALYSIS OF COSMIC RADIATION AT 3500 M. PART B. RESULTS ON THE HARD AND SOFT COMPONENTS. A. Lovati, A. Mura, C. Succì, and G. Tagliaferri (Univ. of Milan, Italy). Nuovo cimento (9) 12, 526-58(1954) Oct. (In English) (cf. NSA 7-602)

A multiplate cloud chamber has been operated at 3,500 metres a.s.l., yielding 16,000 photographs of random expansions. This paper investigates some questions pertaining to the general cosmic ray phenomenology. In particular, the zenith angle dependence of the directional intensities of both hard and soft component is found to follow a squared cosine law. The range 0.3 to 2 bev, the differential energy spectrum of the soft component is shown to be well represented by a power law with exponent  $-2.5$ . The rate of production of nuclear disintegrations in lead and the correlation between the disintegrations and other events are examined. (auth)

## 260

CORRELATIONS FOR NUCLEAR DISINTEGRATIONS PRODUCED BY COSMIC RAYS. M. di Corato, R. Levi Setti, M. Panetti, and P. Pinto (Univ. of Milan, Italy). Nuovo cimento (9) 12, 548-57(1954) Oct. (In Italian)

The statistical analysis of the distribution of about 3,000 cosmic ray stars in nuclear emulsions has demonstrated the presence of a correlation between them, giving a nonrandom distribution of the stars. The magnitude of the effect and its variation with the inverse distance between the stars suggests that it is due to secondary interactions produced by fast neutrons emitted from the stars in the emulsion. (auth)

## 261

REMARK ON AN UNUSUAL COSMIC RAY EVENT. E. Corinaldesi (Dublin Institute for Advanced Studies, Ireland). Nuovo cimento (9) 12, 571-2(1954) Oct. (In English)

The average number of soft photons emitted in a certain energy range by the annihilation of an antiproton was evaluated on the hypothesis that the low energy of the photon would assume high energies when transformed to the laboratory system by the Bloch-Nordsieck method. The average number of photons increases slowly with the momenta of the antiprotons and protons. (J.S.R.)

## CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

### 262

Buffalo Univ.

THE STRUCTURE AND GRAPHITIZATION OF FINE COKE PARTICLES AND OF THERMAL CARBON BLACKS. E. A.

Kmetko. Apr. 15, 1954. 22p. Contract AT(30-1)-1440. (NYO-6102)

The structure of cokes milled to particles of a few microns in diameter was investigated with an electron microscope. The soft coke was found to break up into lamellae (platelets), but hard cokes break into jagged, roughly equiaxed particles characteristic of amorphous substances. Replicas of graphitized carbon-black particles (Thermax) imbedded in a resin were obtained by an especially developed technique. (J.S.R.)

## ELECTRONS

### 263

DIFFRACTION AND INELASTIC SCATTERING OF ELECTRONS. A. Ya. Vyatskin. Zhur. Eksptl'. i Teoret. Fiz. 27, 162-70(1954) Aug. (In Russian).

The phenomena of diffraction and inelastic scattering of electrons of average energies ( $10^2$  to  $2 \times 10^3$  ev in metals), dependent on the coulomb interaction of diffracted electrons with the electron lattice, are examined with respect to the two mutually connected parts of the single process of the passage of electrons through a metal lattice. The presence of a strong effect of diffraction on nonelastic scattering and of nonelastic scattering on diffraction was established. (tr-auth)

### 264

FOCUSING OF A LONG CYLINDRICAL ELECTRON STREAM BY MEANS OF PERIODIC ELECTROSTATIC FIELDS. Ping King Tien (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys. 25, 1281-8(1954) Oct.

This paper presents a theory of focusing long cylindrical electron streams by means of electric fields which vary periodically along the stream. The use of a bifilar helix or a series of annular rings to produce periodic electric fields is considered. The potential distribution at the position of the electrons is expanded in a power series, and an equation of electron motion is written. The solutions obtained indicate that the flow of electrons is essentially parallel, provided that the electrons enter the focusing structure practically without transverse velocities and are distributed across the stream such that the space charge fields decrease radially toward the axis in a manner similar to that of the periodic electric fields. The method of periodic electrostatic focusing is of particular interest in connection with traveling wave tubes. The possibility of using a bifilar helix as both the slow wave and the focusing structure is discussed. (auth)

## GASES

### 265

EQUATION OF STATE OF ARGON. R. H. Christian and R. G. Shreffler (Los Alamos Scientific Lab., New Mexico). J. Appl. Phys. 25, 1341-2(1954) Oct.

## INSTRUMENTS

### 266

Tracerlab, Inc.

INVESTIGATIONS ON UTILIZATION OF RADIOACTIVE ENERGY AS A SOURCE OF BATTERY POWER. QUARTERLY REPORT NO. 5 [FOR] AUGUST 1, 1953 TO OCTOBER 31, 1953. Alexander Thomas and Jane Petrocchi. 47p. Contract DA-36-093-SC-42549. (AD-22922)

The CPD study of metallic surfaces was directed chiefly

towards finding a high work function substitute for platinum. The most promising ones are gold, lead, silver, and molybdenum oxide. With a Mo(oxide)-Mg couple, the difference in CPD with respect to platinum in argon and air can be ascribed entirely to changes in the work function of platinum. One model made in argon with time-stabilized electrode surfaces (sputtered platinum on magnesium) closely checked the open circuit voltage predicted from CPD measurements on individual electrode couples. This model has not suffered marked change in current-voltage characteristics with time. Previous models have also become stable. Although another model made with all-glass insulation did not have the predicted open circuit voltage, it appeared, with some reservations because of the high computed wall absorption of primary particles, to check the saturation current predicted from a Tracerlab-filled tritium capsule. (For preceding period see AD-19099.) (auth)

## 267

Tracerlab, Inc.

INVESTIGATIONS ON UTILIZATION OF RADIOACTIVE ENERGY AS A SOURCE OF BATTERY POWER. QUARTERLY REPORT NO. 6 [FOR NOVEMBER 1, 1953 TO JANUARY 31, 1954. Alexander Thomas and Jane Petrocchi. 68p. Contract DA-36-039-SC-42549. (AD-26498)

A marked advance in the search for a high work function surface was made when it was found that certain surfaces anodized from chemical solution inherently have as much as 0.5 volts higher work function than platinum. The best of these so far has been lead dioxide on stainless steel. Two models made with this high work function surface and with magnesium as the low work function surface gave better than 60 volts. One of the models gave excellent correlation between the voltage predicted from CPD measurements on individual electrode couples. Both models have better correlation of measured saturation current with current predicted from the rated amount of tritium used than most of the previous models. All models had surprisingly high (yet different) temperature coefficients of open circuit voltage. This change in voltage with temperature is probably due to the induced leakage characteristics of the separators. (auth)

## 268

Tracerlab, Inc.

INVESTIGATIONS ON UTILIZATION OF RADIOACTIVE ENERGY AS A SOURCE OF BATTERY POWER. QUARTERLY REPORT NO. 7 [FOR] FEBRUARY 1, 1954 TO APRIL 30, 1954. Alexander Thomas and Jane Petrocchi. 63p. Contract DA-36-039-SC-42549. (AD-31146)

The three models assembled and filled, together with a fourth model assembled but not filled, served to emphasize the importance of selection of insulators and constructional design. With allowance for the effects of these differences, the battery voltage prediction from CPD measurements on individual electrode couples is good, but the current is only 30 to 50% of what is expected from theory. Replacing polystyrene with methyl methacrylate appears to be advantageous. The original intuitive assumptions leading to the recombination coefficient appear to be correct when applied to one rigorous solution of parallel plate ion chamber theory. (For preceding period see AD-26498.) (auth)

## 269

Atomic Energy Research Establishment, Harwell, Berks (England)

A RECORDING OSCILLOSCOPE FOR THE MILLI-MICROSECOND REGION. G. A. Howells. May 17, 1954. 49p. (AERE-EL/R-1420)

An instrument is described which amplifies voltage pulses having rise times in the millimicrosecond region and which enables single pulse to be recorded photographically. It has been designed primarily for use in nuclear research where pulses having rise times of that order are generated by the scintillation counter. An outline is given of some of the salient design factors of the various units comprising the instrument, and a detailed description is given of the circuits used. (auth)

## 270

Atomic Energy Research Establishment, Harwell, Berks (England)

A HIGH SPEED PEN RECORDER AND ITS AMPLIFIER. W. M. Barss. Dec. 1950. 11p. (AERE-G/M-76)

An electro-mechanical pen recorder is described having a linear characteristic and a response time of the order of one second. A model 88 velodyne is used as the electro-mechanical converter. The associated amplifier is of the balanced d-c type and has a gain of 10 ma output (coil current to velodyne) per millivolt input. Provision is made at the input end for several modes of operation. (auth)

## 271

Phillips Petroleum Co. Atomic Energy Div. CALIBRATION OF MTR Co<sup>60</sup> SECONDARY STANDARD. R. K. Stitt. Sept. 17, 1954. 9p. Contract AT(10-1)-205. (IDO-16194)

A secondary Co<sup>60</sup> standard source to be used at the MTR has been calibrated relative to a Co<sup>60</sup> standard received from Argonne National Laboratory. Standard Victoreen ion chambers were used for ionization detectors and the entire apparatus was submerged in the canal at the MTR for shielding purposes. The ion chamber readings were reproducible to within 2% and the standard error given for the Argonne standard was  $\pm 3\%$ . The strength of the MTR secondary standard was determined to be 752 curies  $\pm 5\%$  on August 30, 1954, as compared to 168 curies  $\pm 3\%$  for the ANL standard on August 25, 1954. (auth)

## 272

Knolls Atomic Power Lab.

SIR MARK A DOUBLE-DIAPHRAGM PRESSURE TRANSMITTER FOR THE PRIMARY COOLANT SYSTEM. A. J. Bialous, General Engineering Lab., General Electric Co. Notes compiled by G. G. Heard, Jr. [Knolls Atomic Power Lab.] Oct. 13, 1954. 27p. Contract W-31-109-eng-52. (KAPL-1213)

A pneumatic force-balance type pressure transmitter has been developed and built for use in the SIR primary coolant system for operation up to 100 psig and 1000°F. In addition to design considerations, the choice of metals and welding and fabricating techniques required much study before suitable selections could be made. Performance characteristics under normal and abnormal operating conditions have been determined for the basic unit and its variations. Advantages and limitations of these units are discussed. Laboratory test and field reports indicate credible performance with good accuracy under trying system conditions. (auth)

## 273

Office of Basic Instrumentation, National Bureau of Standards  
DETERMINATION OF SINUSOIDAL ACCELERATION AT



PEAK LEVELS NEAR THAT OF GRAVITY BY THE "CHATTER" METHOD. Charles W. Kissinger. Sept. 1954. 35p. (NBS-3339)

An accelerometer is described in which a loose mass bounces, or chatters, when the peak acceleration of a vertical sinusoidal motion exceeds the acceleration due to gravity. The device is useful, for example, in setting the acceleration level of vibration generators used in the calibration of vibration pickups. A theoretical relation is derived between the amount by which peak acceleration exceeds  $\pm 1$  g and the point in the cycle at which the loose mass, after having separated, again contacts that part of the accelerometer on which it was resting. Using this relation in conjunction with the accelerometer described, acceleration levels from about 1.01 to 1.04 g may be set with an accuracy of approximately  $\pm 0.5\%$  at frequencies up to 60 cps, and with somewhat decreased accuracy to about 150 cps. In the accelerometer described, a clamping screw is provided, by means of which the chatter of the loose mass may be prevented when desired. This allows the accelerometer to be used as a self-calibrating secondary standard for levels of acceleration other than  $\pm 1$  g and at frequencies up to about 1200 cps. (auth)

274

Naval Medical Research Inst., Bethesda  
A HIGH-IMPEDANCE INPUT CIRCUIT SUITABLE FOR ELECTROPHYSIOLOGICAL RECORDING FROM MICRO-PIPETTE ELECTRODES. E. F. MacNichol, Jr., Thomas C. Jenkins Labs. of Biophysics, Johns Hopkins Univ. and Henry G. Wagner, Naval Medical Research Inst., Bethesda. Apr. 22, 1954. 21p. (NM-000-019.03.01)

Recent interest in the use of intracellular microelectrodes for recording the electrical potential across a cell membrane has introduced a number of technical problems for solution. One of these problems concerns the development of special input devices that can be inserted between micropipette electrodes and conventional physiological amplifiers. This report discusses circuits in which a very high input impedance can be achieved without loss in speed of response by the use of both positive and negative feedback principles. A preamplifier that has been constructed using these principles is described in considerable detail. It has been in use for about a year in neurophysiological investigation and has served to demonstrate the validity of the principles on which its operation was based. (auth)

275

A HIGH-RESOLUTION EMISSION ELECTRON MICROSCOPE. G. V. Spivak and A. M. Rozenfeld. Translated from *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* 15, 317-22(1951). 13p. (AEC-tr-1962)

276

A MASS INDICATOR USING A VIBRATING COIL MAGNETOMETER. V. J. Caldecourt and S. E. Adler (Dow Chemical Co., Midland, Mich.). *Rev. Sci. Instr.* 25, 953-5 (1954) Oct.

A vibrating coil magnetometer has been developed which provides precise and continuous indication of the strength of a magnetic field. The device is used on a sector mass spectrometer to obtain both visual mass indication and spectra calibration in the mass range of 2 to 400. (auth)

277

APPARATUS FOR X-RAY DIFFRACTION STUDIES OF METALS UNDER CONTROLLED STRESS AT ELEVATED TEMPERATURE. L. S. Birks (Naval Research Lab.,

Washington, D. C.). *Rev. Sci. Instr.* 25, 963-6(1954) Oct.

A Geiger-counter x-ray spectrometer was constructed for the dynamic study of phase changes and other phenomena in metals under controlled stress conditions at elevated temperatures. Temperature could be controlled from room temperature to the melting point of steel, and stress was independently varied from zero stress to the breaking stress of stainless steel. Applications included isothermal and athermal transformation studies under tensile stress in pearlite, bainite, and martensite. (auth)

278

NEW DESIGN OF A VACUUM JACKET PRECISION COMBUSTION CALORIMETER. P. B. Aitken, Helen L. Boxall, and L. G. Cook (Atomic Energy of Canada, Ltd., Chalk River, Ontario). *Rev. Sci. Instr.* 25, 967-70(1954) Oct.

A vacuum jacket precision combustion calorimeter has been designed, built, and operated. It is rugged, reliable, and easy to disassemble and assemble. The heat leakage is lower by a factor of six than in the air gap types which have been standard since 1915. The calorimeter appears to be capable of giving individual results which deviate not more than 1.5 parts in 10,000 from the mean. (auth)

279

PHOTOELECTRIC COMPARATOR FOR MEASURING OSCILLOGRAMS. H. Bruce Phillips (Argonne National Lab., Lemont, Ill.). *Rev. Sci. Instr.* 25, 971-6(1954) Oct.

A device for measuring photographic oscillogram coordinates is described. By means of a photoelectric balancing technique the instrument allows the locating of the "middle" of a photographic line with an error of the order of a few microns. The "middle" of a line is defined by the instrument as being the point of equal transmission, which is the location on the line at which there are equal amounts of light transmitted on each side. Since the photoelectric comparator is a null device, nervous strain on the operator is greatly reduced. (auth)

280

OPERATING CHARACTERISTICS OF A HIGH YIELD RF ION SOURCE. Harold P. Eubank, Russell A. Peck, Jr., and Rohn Truell (Brown Univ., Providence, R. I.). *Rev. Sci. Instr.* 25, 989-95(1954) Oct.

An r-f ion source has been constructed, which yields up to 15 ma of hydrogen ion current consisting of 80 to 90 percent protons. The ion current yield has been studied as a function of r-f power and frequency, gas pressure, and d-c (extracting) voltage. These relationships are correlated with internal phenomena of the gas discharge and of ion extraction therefrom. (auth)

281

MIXING PREAMPLIFIER. F. J. Davis and P. W. Reinhardt (Oak Ridge National Lab., Tenn.). *Rev. Sci. Instr.* 25, 1024(1954) Oct.

A multichannel preamplifier circuit is described for paralleling a number of phototubes with a minimum signal loss, which is particularly useful where it is desirable to mix signals from widely separated detectors. A simplified circuit is shown for the case where the detectors are close together and cathode followers are not needed. (L.M.T.)

282

A MULTICIRCUIT CONTROL FOR ULTRA-HIGH VACUUM GAUGES. J. H. Reynolds and J. Lipson (Univ. of Calif., Berkeley). *Rev. Sci. Instr.* 25, 1029-31(1954) Oct.

A discussion and diagram are given for this circuit which embodies no new principles, but incorporates ideas from the original circuit of Alpert (J. Appl. Phys, 24, 860(1953)) and others. Versatility is one of its prime attributes. (L.M.T.)

## 283

THE LUMINOSITY OF SPECTROMETERS WITH PRISMS, GRATINGS, OR FABRY-PEROT ETALONS. Pierre Jacquinet (Université de Paris et Centre National de la Recherche Scientifique, Bellevue, Seine et Oise, France). J. Opt. Soc. Amer. 44, 749-59(1954) Oct.

Formulas have been established which express the flux given by a spectrometer as a function of the effective resolving power and of the dimension of the dispersive system (area of the base of the prism, or area of the plates of the étalon). It is thus possible to compare the luminosities of the three types of instruments with, in each case, equal resolving power and equal dimension. This comparison reveals a great superiority of the grating over the prism for all regions of wavelengths, and a great superiority of the étalon over the grating. In the case of the étalon, the overlapping may be overcome by the use of several étalons in series. (auth)

## 284

CINE SPECTROGRAPH. Donald J. Lovell, Harold S. Stewart, Naval Research Lab., Washington, D. C.), and Seymour Rosin (Farrand Optical Co., New York). J. Opt. Soc. Amer. 44, 799-803(1954) Oct.

To study time varying spectral characteristics, a spectrograph has been devised capable of recording successive spectra of an object on continuously driven 70-mm film. Each of the 5000 exposures per second recorded by the instrument consists of five spectra recorded simultaneously. Four of these are of the selected source, with the fifth being of a tungsten source to provide spectral calibration of the film. The film is brought out of a magazine, past a film drum, and onto a takeup spool. The drum has sprocket teeth which engage a length of film in the neighborhood where exposures are made. Attached to the drum is a skirt in which are cut eighty slanting slots. These rotate directly in front of a slit assembly consisting of five parallel slits each fitted with a neutral density filter. The slots act as a shutter, admitting light only through the areas of the slits exposed by a slot. Since unit magnification optics are used, the image travels with the film. Spectrograms of sources available in the laboratory are discussed. (auth)

## 285

THE RESOLVING POWER OF A LARGE BENT CRYSTAL SPECTROGRAPH. Arne Eld Sandstrom (Univ. of Uppsala, Sweden). Arkiv Fysik 8, 129-45(1954).

Some line groups have been recorded with a large bent crystal instrument and a Geiger counter. The x-ray tube is described as well as devices for its adjustment relative to the crystal. To study how the diffraction pattern of the crystal and other broadening effects combine with the natural line width, a special apparatus was built for scale model experiments. The results confirm the validity of the equation  $W_n^2 = W_h^2 + W_c^2$ ,  $W_m$ ,  $W_h$ , and  $W_c$  being the full widths at half maximum of the recorded line, the natural line, and the diffraction pattern, respectively. By means of this equation and comparison with two-crystal measurements the resolving power of the bent crystal instrument has been estimated as regards ideal conditions

as well as in practice. The widths of some L- and M-series lines are given. (auth)

## 286

A NUCLEAR INDUCTOR FOR MEASUREMENTS OF THERMAL RELAXATION TIMES IN LIQUIDS. G. Chiarotti, G. Christiani, L. Goulotto, and G. Lanzi (Istituto di Fisica dell'Università, Pavia, Italy). Nuovo cimento (9) 12, 519-25(1954) Oct. (In English).

A device for measurements of nuclear relaxation times in liquids in the range from  $10^{-2}$  sec to the longest observable times is described. Two equivalent methods are used which are based on the record of "in phase" signals due to the reversal of the nuclear magnetization. (auth)

## 287

A BIBLIOGRAPHY OF THE FREQUENCY-RESPONSE METHOD AS APPLIED TO AUTOMATIC-FEEDBACK-CONTROL SYSTEMS. A. M. Fuchs (Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.). Am. Soc. Mech. Engrs. 76, 1185-94(1954) Nov.

This bibliography of 284 references is first divided into fields of interest, these being presented in an order which permits a logical development of the overall subject matter. The larger fields of interest are subdivided chronologically by years, and within each year alphabetically by the author's name in alphabetical order are also available. Since time limited the bibliography to the frequency-response method, it was necessary to omit references to other broad fields of automatic-feedback-control engineering; for this information the reader is referred to "Bibliography on Feedback Control", Subcommittees on Bibliography on Industrial Control and Feedback Control Systems, Part I — AIEE Paper 53-250; Part II — AIEE Paper 53-251. (L.M.T.)

## ISOTOPES

### 288

Technical Information Service, AEC  
ISOTOPE SEPARATION AND ISOTOPE EXCHANGE. A BIBLIOGRAPHY OF UNCLASSIFIED LITERATURE. G. M. Begun, Oak Ridge National Lab. and Robert E. Allen, Technical Information Service, AEC, comps. Revised June 1954. 126p. (TID-3036(rev.))

The literature is covered from 1907 through 1953 on isotope separation and isotope exchange reactions involving B, C, Cl, H, Fe, Li, N, O, S, and U. Many additional references on isotopes of other elements are presented; however, their coverage is incomplete. Isotope properties, ratio, and kinetic effects are also included. This is a complete revision of TID-3036 issued January 23, 1953. (auth)

## ISOTOPE SEPARATION

### 289

Colorado Univ. Engineering Experiment Station  
SEPARATION OF ISOTOPES BY ELECTROLYSIS FINAL TECHNICAL REPORT. F. A. Rohrman, William J. Utlaut, and Ivan Ceresna. Sept. 13, 1954. 17p. Contract AF(600)-440. (NP-5360)

Continued research on Ni-Ni<sup>63</sup> electrolysis and plating tests showed by counting techniques that some separation of the isotopes was being effected. The condition which seemed to favor the separation of the heavier isotopes of nickel was a low current density which further indicated that the Ni<sup>63</sup> responded more like a metal lower in the electromotive table of the elements. Attempts at



separating  $\text{Ag}^{110}$  and  $\text{Ag}^{111}$  from natural silver and any of the isotopes of uranium were unsuccessful. (auth)

## 290

TEST OF THE SEPARATION OF CALCIUM ISOTOPES BY RADIOMETRIC ADSORPTION ANALYSIS. R. Lindner (Chalmers Technischen Hochschule, Goteborg, Sweden). *Z. Naturforsch.* **9A**, 798(1954) Sept. (In German).

The separation of Ca isotopes by ion exchange was studied by use of  $\text{Ca}^{45}$ . In each case an enrichment of  $\text{Ca}^{45}$  was obtained. (J.S.R.)

## MASS SPECTROGRAPHY

### 291

THE MASS SPECTRUM OF TITANIUM TETRACHLORIDE. J. E. Hogg (Univ. of Toronto, Ontario, Canada). *Can. J. Chem.* **32**, 1039-43(1954) Nov.

An investigation of the mass spectrum of titanium tetrachloride prepared from both commercial titanium dioxide and titanium minerals has been carried out, using a  $180^\circ$  Nier-type mass spectrometer. Values for the relative abundances of the titanium and chlorine isotopes have been found. Measurements of the singly ionized trichloride group show that any variation in the relative abundances of the isotopes of titanium contained in these samples must be less than one per cent. (auth)

## MEASURING INSTRUMENTS AND TECHNIQUES

### 292

Michigan Univ.

NEW MEASUREMENTS OF RADIAL SENSITIVITY OF GM TUBES WITH POINT MILLICURIE SOURCES. Oswald U. Anders and W. Wayne Meinke. [1953] 8p. Contract [AT(11-1)-70]. (AECU-2942)

The radial sensitivity curve of a chlorine-quenched G-M tube was determined for two different counting rates using a millicurie  $\beta$  source of very limited area. A description of the  $\beta$  source ( $\text{Sr}^{90}-\text{Y}^{90}$ ) is included. (L.T.W.)

### 293

Michigan Univ.

A VARIABLE FIELD SURVEY BETA-RAY SPECTROMETER. W. W. Meinke, W. A. Cassatt, and K. L. Hall. June 10, 1954. 42p. Contract AT(11-1)-70. (AECU-2944)

A variable-field survey beta-ray spectrometer for routine nuclear chemical characterizations has been constructed. In operation, charged particles are bent in a  $180^\circ$  arc of 4-cm radius in an atmosphere of hydrogen and are detected with a G-M tube. Construction details and electronic circuitry of the equipment are discussed. Typical beta-ray spectra are shown as an indication of the performance obtained. (auth)

### 294

Atomic Energy Research Establishment, Harwell, Berks (England)

THE APPLICATION OF ELECTRONICS TO THE DETECTION AND MEASUREMENT OF RADIOACTIVITY. A COURSE OF SIX ELEMENTARY LECTURES. H. Bisby. Mar. 12, 1951. 82p. (AERE-EL/L-3)

### 295

Atomic Energy Research Establishment, Harwell, Berks (England)

RADIOACTIVITY MEASURING APPARATUS. Denis

Taylor. Feb. 23, 1949. 9p. (AERE-EL/M-10)

The functions and characteristics of the various component parts of a G-M counter are described, and some details of British equipment available commercially are reported. (L.T.W.)

### 296

Atomic Energy Research Establishment, Harwell, Berks (England)

CONTAMINATION AND RADIATION MONITORING APPARATUS. Denis Taylor. Mar. 16, 1949. 17p. (AERE-MEMO-EL/M-11)

The types of radiation monitors in current use, a brief description of each type, and their availability and approximate price are reported. (J.S.R.)

### 297

Atomic Energy Research Establishment, Harwell, Berks (England)

A THERMAL NEUTRON TIME-OF-FLIGHT SPECTROMETER. P. A. Egelstaff. Apr. 23, 1953. 40p. (AERE-N/R-1131)

An account is given of the construction, setting up, and operation of a thermal neutron spectrometer and its use for the measurement of the total cross sections of Au and Bi and the velocity of neutrons at the back of the thermal column of the Harwell Pile. (auth)

### 298

DuPont de Nemours, E. I., and Co. Explosives Dept., Atomic Energy Div.

A TESTER FOR PILE FLUX MONITORS. L. Cathey. Sept. 1954. 15p. Contract AT(07-2)-1. (DP-79)

A mechanoelectrical instrument is described which is used to calibrate logarithmic micro-microammeters and associated period measuring systems for reactor neutron fluxes. (auth)

### 299

Hanford Works

PROBE TYPE C. P. P. L. Eisenacher. Apr. 20, 1948. Decl. June 19, 1953. 7p. Contract [W-31-109-Eng-52]. (HW-10792)

A new probe-type survey instrument with plug-in probes for range changing uses a C. P. circuit modified to eliminate the range switch. The experimental instrument has probes which give full-scale meter deflections at 0.1, 0.5, and 10 r/hr. The time constant is reported to be quite satisfactory, and linearity is acceptable. (auth)

### 300

Knolls Atomic Power Lab.

TECHNIQUES FOR COUNTING RADIOKRYPTON. M. B. Reynolds. Sept. 22, 1954. 27p. Contract W-31-109-Eng-52. (KAPL-1201)

Geiger-Mueller counters suitable for the determination of the activity of gas samples containing radiokrypton are discussed, along with the sensitivity to be expected. Counting systems using these counters are described briefly. (auth)

### 301

Los Alamos Scientific Lab.

MEASUREMENT OF RISE AND DECAY TIMES OF THREE FAST SCINTILLATORS INCLUDING A SPECIAL PLASTIC. Sidney Singer. Sept. 1953. 28p. Contract W-7405-Eng-36. (LA-1694)

An electronic system has been designed and constructed to measure directly the rise and decay times of the "fast"

scintillators. A pulsed photomultiplier was used to detect the scintillation photons. The photomultiplier pulses were displayed on the screen of a TW-10 traveling wave cathode ray tube using a sweep speed of approximately  $2.5 \times 10^{-9}$  sec/cm. The behavior of the apparatus was checked using trans-stilbene and terphenyl in toluene as scintillators, and the rise and decay times of a special plastic scintillator (terphenyl in polystyrene) were measured. Other experiments, concerned with the behavior of photomultipliers under high pulsed dynode voltages, were also performed. (auth)

### 302

Los Alamos Scientific Lab.

ALPHA FLOOR MONITOR. Mark H. Tattan. Aug. 2, 1954. 23p. Contract W-7405-eng-36. (LA-1713)

The floor monitor, Model FM-1, has been designed to detect alpha contamination. It is a portable type, battery operated instrument which is pushed over the floor like a vacuum cleaner. This report describes the physical design, mechanical and electrical assembly, and operating procedure. (auth)

### 303

Palmer Physical Lab., Princeton Univ.

TECHNIQUES OF COSMIC RAY TIMING EXPERIMENTS. J. W. Keuffel, Palmer Physical Lab., Princeton Univ. and Naval Ordnance Lab. June 14, 1954. 42p. Contract N6onr-270-IL. Technical Report No. 15. (NP-5404)

Fast timing techniques developed by the Princeton cosmic ray group are described. Scintillator-chronotron combinations were developed for the principal purpose of studying meson decay. Circuit diagrams of the particular parts of the timing system are given. (K. S.)

### 304

Radiation Lab., Univ. of Calif., Berkeley

EMULSION TABLES. 1. HEAVY-PARTICLE FUNCTIONS. Walter H. Barkas and George Hahn. May 1954. 22p. Contract W-7405-eng-48. (UCRL-2579)

The measurable features of charged-particle tracks in emulsion are analyzed with regard to their functional dependence on the particle mass, charge, and velocity. Each quantity is then normalized by the appropriate function of the mass and charge so that it becomes a function of velocity alone. A numerical table is constructed in which each such quantity is given as a function of velocity and thus related to all the others. The entries in the table may be interpreted directly for protons, but by virtue of its method of construction, the table applies to all charged particles that are massive compared to an electron. It is supplemented by graphs and interpolation indices for rapid utilization. A table of mass equivalents for elementary particles and light nuclei is included, as well as information concerning the emulsion composition and density. (auth)

### 305

Radiation Lab., Univ. of Calif., Berkeley

THE "COSMIC RAY" EFFECT IN PHOTOMULTIPLIER TUBES. Elton M. Baker and B. M. Tolbert. June 1954. 6p. Contract W-7405-eng-48. (UCRL-2633)

The phenomenon of increased background when two photomultiplier tubes are used in coincidence is explained as a cosmic ray effect due to the latter being absorbed in glass with the resultant emission of light. (auth)

### 306

Radiation Lab., Univ. of Calif., Berkeley

PORTABLE FAST- AND SLOW- NEUTRON SURVEY METER. Boyd W. Thompson. Oct. 8, 1954. 18p. Contract W-7405-eng-48. (UCRL-2748)

To meet the need for a portable survey instrument that will estimate the radiation hazard from fast and slow neutrons, a proton-recoil and BF<sub>3</sub> proportional counter were combined into one instrument utilizing the same high-voltage supply and count rate meter circuitry. The instrument is light weight, has high sensitivity, is essentially nondirectional, and possesses good gamma-ray discrimination. Three ranges are provided, enabling one to read from 0 to 300 to 3000 or to 30,000 slow neutrons/cm<sup>2</sup>/sec. The sensitivity of the fast neutron counter is approximately proportional to energy from 0.1 to 20 Mev, and the three ranges correspond to 0 to 100 to 1000 and to 10,000 Mev/cm<sup>2</sup>/sec. With some prior knowledge of the neutron spectrum to be measured, a fair estimate of the radiation hazard due to fast and slow neutrons can be obtained with this instrument. Drawings of this instrument are available at the following Industrial Depositories: the John Crerar Library; Atomic Industrial Forum; Stanford Research Inst.; Georgia Inst. of Tech. (auth)

### 307

DETERMINATION OF BASIS WEIGHT OF PAPER WITH THE AID OF THE BETA COMPARATOR LKB 3265. (Ytviktsmätning av papper med Betakomparator LKB 3265). Karl-Filip Hansson. Translated by H. A. G. Nathan from Svensk Papperstion. 56, 590-7(1953). 19p. (TT-482)

Data are presented on the calibration and performance of an instrument incorporating an ionization chamber and a  $\beta$  source which was designed for use in determinations of the basis weight of fibrous material and the thickness of homogeneous foils. The method was applied to determinations made at several stages on a moving web of paper, and results are reported. (C.H.)

### 308

ON THE RESOLVING POWER OF PHOTOGRAPHIC EMULSIONS. (Ueber das Auflösungsvermögen von Photographischen Schichten). H. Frieser. Translated by D. A. Sinclair from Kino-Technik 17, 167-72(1935). 16p. (TT-484)

A method of calculating the reduction in contrast (loss of resolving power) due to scattering of light in the photographic emulsion is presented. The work was carried out in two steps. First the conversion of the incident exposure into a new exposure distribution was investigated, then the conversion of this new exposure distribution into a density distribution was examined. It was found that for a sinusoidal exposure distribution the new exposure distribution was also sinusoidal, with the same wave length and phase, but a reduced modulation factor. This factor depends on the wave length, but the mean value does not. By assuming an exponential intensity drop, due to scattering, at the edge of the image of an illuminated slit, a particularly simple expression was found for the dependence of the modulation factor on the wave length. However, this calculated expression is not fully confirmed in practice. The conversion of the true exposure distribution into the density distribution was accomplished with the aid of the density curve in all the cases investigated. (auth)

### 309

PRODUCTION OF OSCILLATIONS IN HALOGEN-



QUENCHED G. M. COUNTERS. D. H. Le Croisette (Southampton Univ., England). Rev. Sci. Instr. **25**, 1023 (1954) Oct.

Recent work on halogen-quenched counters by Zoonen (Appl. Sci. Research B3, 377(1953)) has indicated that the presence of metastable states of atoms in the discharge is responsible for the time delays between the ionizing event and the buildup of an appreciable output pulse. This may also be used to explain the two types of oscillations previously noted by Le Croisette and Yarwood (J. Sci. Instr. **28**, 255(1951)), namely, (a) oscillations in the magnitude of the pulse occurring just after the dead time, and (b) continuous oscillations. In this note the mechanism is postulated for a counter containing Ne at a pressure of 100 mm Hg and Br at a pressure of 0.05 mm Hg. The effect of small additions of A on the de-excitation of the metastable atoms is also discussed. (L.M.T.)

310

PREPARATION OF EMULSION CHAMBERS SUITABLE FOR QUICK TRACING OF ALL TRACKS. Jay Orear (Univ. of Chicago, Ill.). Rev. Sci. Instr. **25**, 1023-4(1954) Oct.

Negligible distortion in following light tracks from one emulsion layer to another may be accomplished by processing and drying the pellicles unmounted. The equipment and processing procedure are discussed, as well as the tracing of a given light track. (L.M.T.)

311

GAMMA-RAY PAIR SPECTROSCOPY WITH INTERMEDIATE-IMAGE FOCUSING. D. E. Alburger (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr. **25**, 1025 (1954) Oct.

The beta spectrometers of Slatis and Siegbahn (Arkiv Fysik **1**, 339(1949)) and Daniel and Bethe (Z. Naturforsch **9a**, 402(1954)) appear to be well suited to purposes of pair measurement since the electrons first form an intermediate image and then reconverge at the detector. This note briefly describes ways of adapting these instruments to the detection of pairs. (L.M.T.)

312

NOTE ON THE ESCAPE PEAK CORRECTION FOR NaI (Tl) CRYSTALS. W. E. Meyerhof and H. I. West, Jr. (Stanford Univ., Calif.). Rev. Sci. Instr. **25**, 1025(1954) Oct.

Monochromatized and collimated x rays entered normally on the central part of NaI crystals ( $\frac{1}{4}$  in. to  $\frac{1}{2}$  in. parallelipeds). The ratio of escape peak to photoelectric peak from 40 to 80 kev was measured, and comparison with calculated curves for good, intermediate, and poor geometries shows good agreement. (L.M.T.)

313

SCINTILLATION COUNTING OF LOW-ENERGY PHOTONS AND ITS USE IN X-RAY DIFFRACTION. J. C. M. Brentano and I. Ladany (Northwestern Univ., Evanston, Ill.). Rev. Sci. Instr. **25**, 1028-9(1954) Oct.

It was reported earlier by the authors (Phys. Rev. **92**, 850(1953)) that in the Mo K $\alpha$  range scintillation counting could be used effectively. In order to obtain a serviceable counter, giving a linear response down to the lowest intensities, it was necessary to obtain a complete separation of the very weak x-ray pulses from interferences. The basic conditions for scintillation counting are discussed in this note, including these interferences. (L.M.T.)

314

MEASUREMENT OF DISTORTION PRODUCED IN GUARDED ELECTROSTATIC FIELDS BY GROUNDED EXTERNAL PLATES. William Miller and R. J. Kennedy (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instr. **25**, 1031-2(1954) Oct.

In the design of free air ionization chambers it is necessary to surround the chamber by a Pb box to stop stray radiation and to provide electrostatic shielding. It is important to determine how close the walls of this box may be placed to the guard plates and wires without distorting the collection volume beyond prescribed limits. The percentage change in collection volume induced by such external grounds can be directly related to a change in resistance between electrodes painted on resistance paper. This resistance paper technique, which gives results accurate to 0.1%, is described in this note. (L.M.T.)

315

DESCRIPTION OF A WILSON CHAMBER. R. R. Roy, Van De Leemput, and M. Étienne (Université Libre de Bruxelles, Belgium). Bull. classe sci. Acad. roy. Belg. **40**, 625-9(1954) June. (In French).

An automatic Wilson cloud chamber is described which permits taking one photograph per minute. (tr-auth)

316

CONTINUOUS DIFFUSION CHAMBER. R. R. Roy and M. L. Goes. Bull. classe sci. Acad. roy. Belg. **40**, 630-6 (1954) June. (In French).

A continuous diffusion chamber is described which gives tracks of sufficient resolution for quantitative analysis of nuclear processes. A pressure of 8 cm Hg is used. (tr-auth)

317

THE PERFORMANCE OF GEIGER-MÜLLER COUNTERS WITH EXTERNAL ELECTRODE AT HIGH COUNTING RATES. M. Daniel Blanc (Coll. de France, Paris). J. phys. radium **15**, 693-4(1954) Oct. (In French).

Counters with an external cathode have been constructed for experiments on their behavior at high counting rates. Performance at high intensity shows that the Geiger threshold is raised and the region of semi-proportionality is enlarged. Excellent stability characteristics were noted, the slope of the characteristic curve decreased steadily, and the length of the plateau was increased. These characteristics are compared with a conventional Geiger tube, and reasons for differences are discussed. (K.S.)

318

A LOW PRESSURE IONIZATION CHAMBER FOR THE MEASUREMENT OF NEUTRON DISTRIBUTION IN A PILE. I. Pelchowitch and J. Weill (Commissariat à l'Énergie atomique, Centre d'Études nucléaires de Saclay). J. phys. radium **15**, 119A-20A(1954) Oct. (In French).

A low-pressure ionization chamber of B is used to measure thermal neutron flux up to  $10^{13}$  neutron/sec/cm<sup>2</sup>. The rapid response time of the system indicates that the chamber can be used to measure the density distribution of neutrons in a reactor. (tr-auth)

319

ON THE FIXING OF NUCLEAR EMULSIONS. J. P. Lonchamp and H. Braun (Institut Physique de Strasbourg). J. phys. radium **15**, 139A-44A(1954) Oct. (In French).

The effect of several factors on the kinetics of fixing nuclear emulsions is studied. The factors are: concentra-

tion of the fixing bath, chemical composition of the fix, the effect of agitation, and the nature of the emulsion. The results obtained sometimes deviate from those obtained with ordinary emulsions. The use of  $\text{NH}_4\text{HSO}_4$  for the fix yields certain advantages. It is noted, in addition, that the attack of Ag grains after development is not prohibitive. (tr-auth)

### 320

NEW TRENDS IN DOSIMETRY. A. Allisy. *J. radiol. et électrol.* 35, No. 7-8, 572-7(1954). (In French).

Reasons are advanced for basing radiation dosimetry on a measurement of the effects produced by the radiation at a point, rather than on a measurement of the quantity of radiation at that point. (J.S.R.)

### 321

ALPHA-GAMMA DIRECTIONAL CORRELATION MEASUREMENTS WITH LIQUID FILM SOURCES. T. B. Novey (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 96, 547-8(1954) Oct. 15.

Observed discrepancies in the  $\alpha$ - $\gamma$  directional correlation of several nuclides have been explained on the basis of the electric quadrupole interaction due to the presence of large electric field gradients in the solid sources used. Evidence is presented here that the use of thin liquid film sources will reduce or eliminate these attenuations due to quadrupole interaction. This allows the correlations to be studied at more convenient resolving times. (L.M.T.)

### 322

PHOTO-ELECTRIC MASS DETERMINATIONS IN NUCLEAR EMULSIONS. PART III. DESCRIPTION OF THE NEW EXPERIMENTAL ARRANGEMENTS. S. v. Friesen and L. Stigmark (Univ. of Lund, Sweden). *Arkiv Fysik* 8, 121-7 (1954).

An experimental arrangement is described for the rapid and precise semiautomatic counting of particle tracks in a nuclear emulsion. The photoelectric system provides for the measurement of slow charged particle tracks at a rate of about 1400  $\mu$  per hour. (K.S.)

### 323

COUNTERS WITH RANDOM DEAD TIME. Alladi Ramakrishnan (Univ. of Madras, India). *Phil. Mag.* (7), 45, 1050-2(1954) Oct.

The problem of determining the probability distribution function  $\pi(n,t)$  of the number of registered events  $n$  in a time interval  $t$  when the dead times following the registered and unregistered events are themselves stochastic variates is solved using a method developed recently by the author and P. M. Mathews. (auth)

## MESONS

### 324

MEASUREMENTS OF FORTY-FOUR CHARGED V-EVENTS. J. S. Buchanan, W. A. Cooper, D. D. Millar, and J. A. Newth (Manchester Univ., England). *Phil. Mag.* (7), 45, 1025-42(1954) Oct.

The measurements made on 44 charged V events are reported and discussed. Arguments are presented to show that most of the events are not the decays of  $\tau$  or  $K_\mu$  mesons, nor are they 'cascade' decays. The simplest explanation of the majority of the events is that they are decays of a heavy meson into a light charged meson and two light neutral particles. From the results of other experiments the charged secondary particles are probably

$\mu$  mesons. The primary particle in one event has a mass of at least  $(1184 \pm 90)m_e$ . This event is discussed in detail. On the assumption that all the events are of the same type, the mean lifetime of the primary particles is found to be greater than  $2 \times 10^{-8}$  sec. Attempts to distinguish a group of particles with a shorter mean lifetime have failed. Twenty-nine of the primary particles are positively charged, thirteen negatively; the signs of two particles cannot be determined. The positive excess is attributed, in the main, to a statistical fluctuation. (auth)

### 325

EVIDENCE FOR THE  $\beta$ -DECAY OF A K-MESON. M. W. Friedlander, D. Keefe, M. G. K. Menon, and L. van Rossum (Univ. of Bristol, England). *Phil. Mag.* (7), 45, 1043-9(1954) Oct.

The decay at rest of a K meson in which the secondary particle appears to be an electron of  $\sim 90$  Mev has recently observed. The secondary particle, after traversing a distance of 2.3 cm in the emulsion, appears to have been sharply deviated; thereafter, the track is closely similar to that of a slow electron. The grain density in the track, before and after the deviation, is indistinguishable from the 'plateau value'. The most plausible explanation of this behavior is that it is due to the sudden loss of energy of an electron through the production of bremsstrahlung. Alternatively, the secondary particle could be assumed to be (a) a  $\pi$  meson which interacts with a nucleus and undergoes charge exchange, the product nucleus subsequently suffering  $\beta$  decay, or (b) a  $\mu$  meson which decays in flight. The last two possibilities have been considered and appear very improbable. (auth)

### 326

A CLOUD CHAMBER STUDY OF THE INTERACTIONS OF FAST  $\mu$ -MESONS. V. Appapillai, A. W. Mailvaganam, and A. W. Wolfendale (Univ. of Ceylon). *Phil. Mag.* (7), 45, 1059-69(1954) Oct.

A cloud chamber operating in a magnetic field has been used to investigate the production of penetrating secondaries by  $\mu$  mesons at sea level. No definite events in which single penetrating secondaries are produced (APP) have been observed. Some possible explanations for the high cross sections for production of APP found by earlier workers are discussed. Events in the cloud chamber attributed to the nuclear interaction of  $\mu$  mesons can be explained in terms of the virtual photon interaction postulated by George and Evans (1950). (auth)

### 327

MATRIX ELEMENTS FOR DOUBLE PION PHOTOPRODUCTION. R. Gatto (Univ. of Rome, Italy). *Nuovo cimento* (9) 12, 568-70(1954) Oct. (In English)

The consequences of the hypothesis of charge independence for double pion photoproduction are discussed. Some general consequences of charge independence for multiple photoproduction are also stated. (J.S.R.)

### 328

ON THE QUESTION OF STOPPING OF HEAVY NEGATIVE MESONS IN PHOTOEMULSIONS. M. I. Podgoretskii. *Zhur. Eksptl. i Teoret. Fiz.* 26, 255-6(1954) Feb. (In Russian)

### 329

POLY-PHENOMENOLOGICAL THEORY OF THE INTERACTION OF  $\pi$  MESONS BY NUCLEONS. I. E. Tamm, Yu. A. Gol'fand, and V. Ya. Fainberg. *Zhur. Eksptl. i Teoret. Fiz.* 26, 649-67(1954) June. (In Russian).



On the basis of the polyphenomenological theory of the interaction of  $\pi$  mesons with nucleons the hypothesis of the existence in nucleons (besides the basic states) of an excited (isobaric) state, the regular and isotopic spin of which is  $\frac{1}{2}$ , is discussed. The theory is based on relativistic invariance. The problem of the scattering of  $\pi$  mesons by nucleons is examined with the calculation of attenuation. By the proper choice of values in the theory of four free parameters satisfactory agreements with experimental data are obtained both in the angular distribution of scattered  $\pi$  mesons and in the dependence of the total cross section on the energy in all investigated intervals of energy. (tr-auth)

### 330

ON THE QUESTION OF MESON-NUCLEON INTERACTIONS. D. A. Kirzhnits. *Zhur. Eksptl. i Teoret. Fiz.* 27, 6-18 (1954) July. (In Russian).

The question of the interaction of nucleons with a meson field in the general form was discussed, and it was shown that, together with the usually discussed interaction, an interaction connected with the nucleon impulse exists. It was also shown that for the final equivalent presence of a nucleon, depending on the mass field, a given repulsion even with an attractive force field leads to the appearance of a barrier. The appearance of nonlinearity in the Hamiltonian was noted. (tr-auth)

### 331

STATISTICAL METHOD OF DETERMINING THE MASS OF UNSTABLE NEUTRAL PARTICLES AND THEIR DECAY PRODUCTS. G. E. Chikovani. *Zhur. Eksptl. i Teoret. Fiz.* 27, 110-12 (1954) July. (In Russian).

Formulas are developed for calculating the mass of  $V^0$  particles and their two decay products. The mass of  $V^0$  is  $M = 2196 \pm 3m_e$  and of one decay product is  $M = 280 \pm 28 m_e$ . The mass of the  $V^0$  particle is in good agreement with experimental results. (J.S.R.)

### 332

RADIATION CORRECTION IN THE LIFE OF  $\pi^0$  MESONS. A. D. Galanin and V. G. Solov'ev. *Zhur. Eksptl. i Teoret. Fiz.* 27, 112-15 (1954) July. (In Russian).

### 333

SOME REGULARITIES OF THE DECAY OF MESONS TO THREE PARTICLES. M. I. Podgoretskii and I. L. Rozental. *Zhur. Eksptl. i Teoret. Fiz.* 27, 129-34 (1954) Aug. (In Russian).

The calculation of the energy spectrum of secondary particles, generated by meson decay to three particles and coupled with the primary particle was generalized. For relativistic and nonrelativistic cases the energy and angular distribution of the secondary particles was calculated in a laboratory coordinate system. The characteristic angular distribution of the non-coplanarity of  $\pi$ -meson tracks, caused by the decay of bound  $\tau$  mesons was estimated. (tr-auth)

### 334

ON THE NATURE OF  $\tau$  MESONS AND  $V^0_2$  PARTICLES. I. S. Shapiro. *Zhur. Eksptl. i Teoret. Fiz.* 27, 257-8 (1954) Aug. (In Russian).

The isotopic similarity of  $\tau^\pm$  mesons and  $V^0_2$  particles is possible if the particles of the same type appear with vectors (spin 1, parity -1) or if the spin of these particles is a very large unit. If  $\tau^\pm$  mesons and  $V^0_2$  particles have isotopic similarity, then, along with the decay of  $\tau^\pm$

mesons to three charged  $\pi$  mesons, there ought to be (and with no smaller probability) a decay to two particles - a charged and a neutral  $\pi$  meson. If the  $V^0_2$  particles and  $\tau^\pm$  mesons form an isotopic triplet (i.e., if the isotopic spin of  $V^0_2$  particles is 1), then comparatively stable  $V^0_2$  particles decay to two neutral mesons. With isotopic spin of 0,  $\frac{1}{3}$  of all  $V^0_2$  particles decay to two  $\pi^0$  mesons. It is concluded that the experimental detection of  $\tau^\pm \rightarrow \pi^\pm \pi^0$  would be evidence of the isotopic similarity of  $V^0_2$  particles and  $\tau^\pm$  mesons, whereas the demonstration of the absence of the phenomenon or the establishment of the fact of  $V^0_2$  decay to two  $\pi^0$  mesons would completely exclude such a hypothesis. (tr-auth)

### 335

THE GREEN FUNCTION FOR THE INTERACTION OF NUCLEONS WITH MESONS. E. S. Fradkin. *Doklady Akad. Nauk S.S.S.R.* 98, 47-50 (1954) Sept. 1. (In Russian).

A brief development of a system of functional equations defining the S matrix of the interaction of nucleons with mesons is presented. For simplicity only the case of the interaction of nucleons with neutral pseudoscalar mesons by means of pseudoscalar bonds is considered. (J.S.R.)

### 336

DAMPING EFFECT IN THE GAMMA-DECAY OF A NEUTRAL PION. Junji Iwadare (Kyoto Univ., Japan) and Kazuhiko Nishijima (Osaka City Univ., Japan). *Progr. Theoret. Phys. (Japan)* 12, 108-9 (1954) July.

Brueckner et al., (*Phys. Rev.* 90, 476 (1953)) while investigating pion-nucleon scattering found in the ps-ps meson theory that the virtual nucleon pair formation is strongly damped by the inertia of the self-field of a nucleon. Consequently, at low energies, the s-state meson scattering which occurs through the virtual nucleon pair formation is weakened and the p-state scattering without the pair formation is relatively enhanced since the latter is almost undamped. This information aids the authors in estimating the damping effect in the decay of a neutral pion. (L.M.T.)

### 337

ON MESON-MESON INTERACTION. Walter Thirring (Univ. of Bern, Switzerland). *Z. Naturforsch.* 9A, 804-5 (1954) Sept. (In German).

It is shown that the explanation of the saturation of nuclear force by a repulsive force between  $\pi$  mesons leads to a disagreement with the measured scattering cross section of mesons by nuclei when there is a strong repulsion between the mesons. (J.S.R.)

### 338

PRECISION MEASUREMENT OF THE NEGATIVE PION MASS FROM ITS RADIATIVE ABSORPTION IN HYDROGEN. Kenneth M. Crowe and Robert H. Phillips (Univ. of California, Berkeley). *Phys. Rev.* 96, 470-83 (1954) Oct. 15.

The gamma-ray spectrum of the reaction  $\pi^- + p \rightarrow n + \gamma$  has been remeasured with an improved design of the high-energy pair spectrometer. This design has taken advantage of one of the focusing properties of a 90-degree wedge-shaped magnetic field to minimize the effect on the resolving power of multiple scattering of the pair fragments in the converter. The theory of the spectrometer is developed in detail. The accuracy of the energy scale depends on magnetic field measurements and the calculation of orbits, aberrations, and resolving power. By the determination of the mesonic absorption gamma-ray energy, a

precise mass value for the negative pion has been found:  $M_{\pi^-} = 272.7 \pm 0.3 m_e$ . From the  $\pi^- - \pi^0$  mass differences already obtained by Panofsky, Aamodt, and Hadley (PAH), by Chinowsky, Sachs, and Steinberger (CSS), and the  $\pi^- - \mu^-$  mass difference obtained by Lederman, Tinlot, and Booth (LTB), it is possible to improve the mass values for the  $\pi^0$  and the  $\mu^-$  mesons. From  $\pi^- - \pi^0$  (PAH):  $M_{\pi^0} = 26.2 \pm 2.0 m_e$ ; from  $\pi^- - \pi^0$  (CSS):  $M_{\pi^0} = 263.9 \pm 0.7 m_e$ ; from  $\pi^- - \mu^-$  (LTB):  $M_{\mu^-} = 206.7 \pm 3.0 m_e$ . If one assumes that the positive and negative pions have the same mass, the mass of the positive muon can also be deduced from the work of Birnbaum, Smith, and Barkas:  $M_{\mu^+} = 206.3 \pm 0.3 m_e$ . (auth)

### 339

POSSIBLE EXISTENCE OF A NEW HYPERON. Y. Eisenberg (Cornell Univ., Ithaca, N. Y.). Phys. Rev. **96**, 541-3(1954) Oct. 15.

An unusual event was found in a stack of 42 Ilford G-5 400- $\mu$  stripped emulsions flown for 6  $\frac{1}{2}$  hrs at 41°N geomagnetic latitude.  $K_1$  originates in a 5 + 11<sub>p</sub> star produced by a fast charged particle of energy  $\sim 30$  Bev, travels  $\sim 5,720 \mu$  to a 10° deflection point where  $K_2$  starts.  $K_2$  travels  $\sim 21,900 \mu$  in the emulsion before coming to rest, giving rise to a 5-prong star [three protons, an  $\alpha$  particle, and an L meson ( $\pi$  or  $\mu$ )]. Evidence points to this being an example of decay in flight of a negative hyperon  $Y_1^-$ . If  $Y_1^- \rightarrow K_2^- + n + Q$ , then  $M(Y_1) \approx 2830 m_e$ ; if  $Y_1^- \rightarrow K_2 + \Lambda^0 + Q$ , then  $M(Y_1) = 3160 m_e$ . The direct mass measurement of  $Y_1$  by scattering vs. ionization gave  $M(Y_1) = (3200_{-500}^{+1200}) m_e$ . (L.M.T.)

## METEOROLOGY

### 340

Argonne National Lab.  
SUMMARY OF METEOROLOGICAL DATA TAKEN AT ARGONNE NATIONAL LABORATORY, DU PAGE COUNTY, ILLINOIS, JULY 1952 THROUGH JUNE 1953. Apr. 1954. 144p. Contract W-31-109-eng-38. (ANL-5256)

Climatological measurements made at representative locations on the Argonne site during the year are summarized. Data are included from soil-temperature studies. A description of each of the meteorological instruments used is included. (For preceding period see BNL-2928.) (C. H.)

### 341

Pennsylvania State Coll. Mineral Industries Experiment Station  
THE COOPERATIVE TURBULENCE STUDY OF AUGUST 30-31, 1951 AT THE BROOKHAVEN NATIONAL LABORATORY. SCIENTIFIC REPORT NO. 1. H. A. Panofsky. June 15, 1952. 54p. Contract AF19(604)-166. (NP-5356)

Some results are presented from a cooperative turbulence study at the Brookhaven National Laboratory, August 30-31, 1951. The following conclusions were drawn: (1) fluctuations of individual elements as measured by different instruments at the same time and level are well correlated. The spectral distributions of the energy, heat flux, and stress as determined from the different instruments agree fairly well; (2) on the days in question, exchange coefficients for heat and momentum were the same only at the relatively low level of 75 ft. At 300 ft, the momentum coefficient was several times the heat coefficient. The heat coefficient was nearly constant with height, whereas the momentum co-

efficient increased rapidly; (3) ten-second averages of the variables are sufficient to estimate the fluxes at 300 ft within a few per cent, and at 75 ft within about 10%; (4) the stress determined from wind speed and vertical velocity only is nearly the same as the component of the stress vector in the mean wind direction; (5) high-frequency eddies contribute more to the energy than to the fluxes; (6) high-frequency eddies contribute far more to the energy and fluxes at 75 ft than at 300 ft. (7) the author's working hypothesis seems oversimplified. An additional hypothesis is suggested, which fits the observations equally well, and also fits the Kolmogoroff law at high frequencies. (auth)

## MICROWAVES

### 342

Laboratory for Insulation Research, Mass. Inst. of Tech.  
LINE BROADENING AND DIELECTRIC RELAXATION IN COMPRESSED GASES. C. S. E. Phillips. Oct. 1954. 24p. Contract N5ori-07801, Technical Report No. 88. (NP-5405)

A first attempt is made to investigate the transition from resonance to relaxation spectrum by high-pressure research in the microwave region. Equipment has been developed for studying the dielectric constant and loss of gases and liquids in the K-band region up to 1000 atmospheres at temperatures up to 300°C. Measurements on a nearly spherical molecule of strong dipole moment ( $\text{CHClF}_2$ ), on a linear molecule of weak dipole moment ( $\text{N}_2\text{O}$ ), and on mixtures of  $\text{CHClF}_2$  with nitrogen are reported, and a preliminary discussion of the results is given. (auth)

### 343

A SIMPLE HIGH-TEMPERATURE MICROWAVE SPECTROGRAPH. P. A. Tate and M. W. P. Strandberg (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr. **25**, 956-8(1954) Oct.

A microwave absorption cell of simple construction has been designed to work in the temperature range of 600 to 1000°C. The cell consists of a piece of stainless steel wave guide equipped with a Stark septum and enclosed in a Vycor envelope. The furnace and temperature control equipment used with the cell are described. Electronic detection equipment is similar to that used with other Stark-modulation microwave spectrographs. (auth)

## MOLECULAR PROPERTIES

### 344

EXCITATION ENERGIES OF  $\text{Li}_2$ -MOLECULE. A. Rahman (Univ. of Louvain, Belgium). Physica **20**, 623-32(1954) Sept. (In English)

$\text{Li}_2$  is treated as a two-electron problem with the atomic K shells merged into the nuclei. The molecular orbitals are built out of 2s, 2p<sub>x</sub>, y, z atomic orbitals centered on each nucleus, the exponent in the 2s and 2p functions being the same. The excitation energies for the transitions  $^1\Sigma_u^+ - ^1\Sigma_g^+$ ,  $^1\Pi_u - ^1\Sigma_g^+$  as calculated by the usual anti-symmetrized molecular orbitals, linear combination of atomic orbitals (A.S.M.O., L.C.A.O.) theory are given first and compared with experimental values; as expected there is wide discrepancy, the position being worse at infinite internuclear separation than in the neighborhood of the equilibrium distance. Moffitt's idea of "atoms in molecules" is applied then to this model for  $\text{Li}_2$ . It is found that on this simplified model the application of the method leads to quite wrong values for the excitation energies when all the configurations



used in the A.S.M.O., L.C.A.O. calculation are included in the scheme. It is found that on leaving out the purely ionic configurations, i.e., the configurations representing  $\text{Li}^+$  and  $\text{Li}^-$  as interacting units, the results are as satisfactory as could be desired in the circumstances, the discrepancy between calculated and experimental values being always less than 0.3 ev. An unobserved higher  $^1\Pi_u$  state is investigated showing a minimum of energy. (auth)

345

VIBRATIONAL SPECTRA AND CONSTANT POTENTIAL ENERGY OF ETHYLENE AND ITS DEUTERIUM SUBSTITUTE. L. M. Sverdlov and N. L. Pakhomova. Zhur. Eksp. i Teoret. Fiz. 26, 64-78(1954) Jan. (In Russian)

On the basis of a new interpretation of the vibrational spectra of  $\text{C}_2\text{H}_4$  and  $\text{C}_2\text{D}_2$ , the constant potential energy of the ethylene molecule was calculated, and the frequency and form of the normal vibration of all D-substituted ethylenes was obtained. (tr-auth)

## NEUTRONS

346

Chalk River Project (Canada)

NEUTRON DENSITY IN AN INFINITE, NON-CAPTURING MEDIUM SURROUNDING A LONG CYLINDRICAL BODY WHICH SCATTERS AND CAPTURES NEUTRONS. S. A. Kushneriuk and C. McKay. July 1954. 81p. (CRT-566; AECL-137)

The asymptotic neutron density in a purely scattering medium of infinite extent, into which is inserted an infinitely long cylinder which scatters and captures neutrons is derived from the integral equation defining the density, using as a basis a variational procedure, perturbation methods (for cylinders of small and large radii) and Wiener-Hopf type of analysis (for cylinders of infinitely large radii). It is assumed that the neutron sources are infinitely far from the cylindrical body and that the scattering in the medium surrounding the cylinder is elastic and isotropic. It is known that under these conditions the form of the space dependence of the asymptotic neutron density distribution coincides with the form of the solution for the density distribution in the diffusion approximation and thus a knowledge of the correct asymptotic neutron density distribution effectively provides a boundary condition for the diffusion differential equation. Specifically, the following varieties of media comprising the cylindrical body are considered: (1) the cylindrical body is homogeneous and captures neutrons only; (2) as in (1) with the addition of scattering; (3) the cylindrical body is composed of a homogeneous inner region which captures neutrons only, and which is surrounded by an air gap or a thin, weakly absorbing sheath or both; (4) as in (3) with the addition of scattering in the inner medium. (auth)

347

INTRODUCTION TO THE THEORY OF NEUTRON DIFFUSION. VOLUME 1. K. M. Case (Univ. of Michigan), F. de Hoffmann, B. Carlson, and M. Goldstein (Los Alamos Scientific Lab.), and G. Placzek (Princeton Univ.). 174p., June 1953, Available from GPO, \$1.25.

A theory of neutron diffusion is proposed whereby the distribution of neutrons in space and time can be determined in terms of the geometrical configuration and physical properties of the medium. The discussion is limited to one-velocity problems in which it is assumed that the magnitude of the neutron velocity is unchanged on collision.

After a description of streaming in vacuum, the motion of neutrons in absorbing nonscattering media is considered. The general problem of one-velocity neutron diffusion is considered. (L.T.W.)

## NUCLEAR PHYSICS

348

Ohmart Corp.

STUDY AND DEVELOPMENT OF NUCLEAR BATTERIES. INTERIM ENGINEERING REPORT NO. 4. [nd]. 69p. Contract AF33(616)-172. (AD-29337)

Additional work was done on the plating of electrodes for further development of the nuclear battery. The electrodes were prepared by depositing rhodium, thallium, or indium upon brass shim stock or stainless steel by the immersion and applied voltage method. Rhodium, plated on stainless steel, produced the highest open circuit voltage (1.5v) when used with a magnesium anode. The highest open circuit voltage (0.9v) of thallium on brass shim stock was also produced when using a magnesium anode. Indium, plated on brass shim stock, with a magnesium anode produced the highest open circuit voltage of 1.3v. Work done on preparing active electrodes by dipping the electrode assembly into molten sodium and by evaporation of aluminum and magnesium is discussed. Temperature coefficients were further investigated and the results of gold vs cadmium and gold vs zinc are given. Theoretical work was continued, and a theory was developed for the open circuit voltage of a cell for the phase pertaining to the collection of ions in a gas in which the ions are being continuously produced. The results show that the voltage should increase with electrode spacing, specific ionization, as the pressure increases. Testing of the Model "W" cell produced these conclusions: 1) argon is more suitable than sulphur-hexafluoride as a filling gas, 2) current output is not linear with source size, 3) changes in current output vs ion collection voltage on a percentage basis for a one curie strontium-90 source were less than those obtained employing the 540 microcurie source, 4) greater current output could be obtained by increasing the operating pressure and/or source size, 5) no peak current seems to be present for argon filling gas and a one curie source. Five Model "T" cells were tested, each containing one curie of tritium. The electrodes used were: one aluminum to lead dioxide, one lead to lead dioxide, and three aluminum to carbon. Work done on the Model "E" consisted of temperature coefficients, variation of load resistance vs internal impedance, and the stray-radiation field about the cell. With lead and lead dioxide electrodes, the temperature coefficients were quite good and showed a linear trend. The internal impedance increases linearly with the load resistance. The stray radiation field is such that no shielding is necessary for distances greater than 7 inches from the cell. (auth)

349

RECENT DEVELOPMENTS IN NUCLEAR PHYSICS. John Cockcroft (Atomic Energy Research Establishment, Harwell, Berks, England). *Atomics* 5, 279-85; 294(1954) Oct.

350

SOME PROPERTIES OF NUCLEAR NORMAL MODES. Igram Bloch and Yu-Chang Hsieh (Vanderbilt Univ., Nashville, Tenn.). *Phys. Rev.* 96, 382-5(1954) Oct. 15.

Energy levels and antisymmetric eigenfunctions are calculated, with the aid of normal coordinates, for a

nuclear Hamiltonian containing inter-nucleon potentials of the Hooke's law type. Such a nuclear model exhibits the same shell structure as do the same nucleons moving without interaction in a common harmonic-oscillator central field. Modifications in the Hamiltonian—use of force parameters which depend on  $A$ , cutting off of forces at finite range, inclusion of spin-orbit forces—are discussed in connection with shell structure and the nuclear photoeffect. (auth)

### 351

MODEL FOR NUCLEAR REACTIONS WITH NEUTRONS. H. Feshbach, C. E. Porter, and V. F. Weisskopf (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. **96**, 448-64(1954) Oct. 15.

A simple model is proposed for the description of the scattering and the compound nucleus formation by nucleons impinging upon complex nuclei. It is shown that, by making appropriate averages over resonances, an average problem can be defined which is referred to as the "gross-structure" problem. Solution of this problem permits the calculation of the average total cross section, the cross section for the formation of the compound nucleus, and the part of the elastic-scattering cross section which does not involve formation of the compound nucleus. Unambiguous definitions are given for the latter cross sections. The model describing these properties consists in replacing the nucleus by a one-body potential which acts upon the incident nucleon. This potential  $V = V_0 + iV_1$  is complex; the real part represents the average potential in the nucleus; the imaginary part causes an absorption which describes the formation of the compound nucleus. As a first approximation a potential is used whose real part  $V_0$  is a rectangular potential well and whose imaginary part is a constant fraction of the real part  $V_1 = \xi V_0$ . This model is used to reproduce the total cross sections for neutrons, the angular dependence of the elastic scattering, and the cross section for the formation of the compound nucleus. It is shown that the average properties of neutron resonances, in particular the ratio of the neutron width to the level spacing, are connected with the gross-structure problem and can be predicted by this model. The observed neutron total cross sections can be very well reproduced in the energy region between zero and 3 Mev with a well depth of 42 Mev, a factor  $\xi$  of 0.03, and a nuclear radius of  $R = 1.45 \times 10^{-13}$  cm. The angular dependence of the scattering cross section at 1 Mev is fairly well reproduced by the same model. The theoretical and experimental values for the ratios of neutron width to level distance at low energies and the reaction cross sections at 1 Mev do not agree too well but they show a qualitative similarity. (auth)

### 352

A REMARK ON NEUTRON-PROTON MASS DIFFERENCE. Yasuo Oishi (Kochi Ottemae High School, Japan) and Hiroshi Katsumori (Osaka Gakugei Univ., Japan). Progr. Theoret. Phys. (Japan) **12**, 109-11(1954) July.

Feynman and Speisman (Phys. Rev. **94**, 500(1954)) showed the possibility of explaining the  $n$ - $p$  mass difference out of the difference of their electromagnetic self energies calculated by the phenomenological introduction of a Pauli term representing the anomalous magnetic moment coupling. The authors independently carried out calculations based on the same idea, but involving different cutoff techniques. The calculations are briefly summarized in this note since com-

parison with Feynman's seems to serve as a reference to know how sensitively the cutoff techniques effect the results, and if one may give reasonable physical meanings to cutoff factors. (L.M.T.)

## NUCLEAR PROPERTIES

### 353

[European Council for Nuclear Research]  
UN NOUVEAU MODELE D'OSCILLATEUR A SPIN.  
(A New Spin Oscillator Model). R. Gabillard. Oct. 1954. 8p. (CERN-PS/RGb-5)

An apparatus is described which utilizes the nuclear magnetic resonance of  $H_2O$  to produce a frequency which can be accurately controlled by regulating the current flow in a solenoid enclosing a fixed-frequency emitter coil and a receiver coil. An accurately calibrated tube carrying  $H_2O$  at a given flow rate is mounted coaxially in the center of the solenoid. Applications of the device are discussed. (K. S.)

### 354

National Bureau of Standards  
[ALIGNMENT<sup>141</sup> AND NEODYMIUM<sup>147</sup> NUCLEI]. PROGRESS REPORT TO THE OFFICE OF NAVAL RESEARCH, JULY 1, 1953-SEPTEMBER 30, 1954. [E. Ambler and R. P. Hudson, National Bureau of Standards and G. M. Temmer, Carnegie Institution of Washington]. Sept. 30, 1954. 40p. Contract NA-onr-17953. (NBS-3674)

The radioactive nuclei  $Ce^{141}$  and  $Nd^{147}$  have been aligned by the magnetic hfs method (Bleaney) using single crystals of cerium magnesium nitrate. The cerium site is characterized by  $B \gg A$ , i.e., the "alignment" occurs in a plane. The anisotropies for the 142-keV gamma ray of  $Ce^{141}$ , and the 92-keV and 530-keV gamma rays of  $Nd^{147}$ , at the lowest temperature (0.00308°K) were found to be +0.12, 0 and -0.29, respectively. These values coupled with the rate of change of anisotropy with temperature identify the transitions as  $M1$ ,  $M1 + E2$  and  $E2$ , respectively. The decay schemes supported by these experiments are as follows:

$Ce^{141}$  (142 keV),  $\frac{1}{2}^- \rightarrow \frac{1}{2}^+ + \frac{1}{2}^+ \frac{5}{2}^+$ ;  $Nd^{147}$  (92 keV),  $\frac{9}{2}^- \rightarrow \frac{7}{2}^+ + \frac{1}{2}^+ \frac{5}{2}^+$ ;  $Nd^{147}$  (530 keV),  $\frac{9}{2}^- \rightarrow \frac{9}{2}^+ + \frac{2}{2}^+ \frac{5}{2}^+$ . From the temperature dependence of the anisotropies we can deduce values for the magnetic moments as follows:  $Ce^{141}$ ,  $0.16 \pm 0.06$  n.m.;  $Nd^{147}$ ,  $0.22 \pm 0.05$  n.m. These rather small values for odd-neutron nuclei may not be meaningful because of possible internal magnetic field effects in the crystal which are not taken into account in the treatment of the hyperfine interaction. (auth)

### 355

ON THE CALCULATION OF THE NUCLEAR MAGNETIC MOMENT ON THE BASIS OF THE  $j$ - $j$  BONDING BETWEEN PROTONS AND NEUTRONS. I. A. Vaisman. Zhur. Eksptl. i Teoret. Fiz. **26**, 754-6(1954) June. (In Russian).

The nuclear configuration and nuclear magnetic moment of  $H^3$ ,  $He^3$ ,  $B^{11}$ ,  $C^{13}$ ,  $N^{15}$ ,  $O^{17}$ ,  $Al^{27}$ ,  $Si^{29}$ ,  $P^{31}$ ,  $S^{33}$ ,  $K^{39}$ ,  $K^{41}$ ,  $Li^7$ ,  $Be^9$ ,  $F^{19}$ ,  $Mg^{25}$ ,  $Cl^{35}$ , and  $Cl^{37}$  were calculated on the basis of the  $j$ - $j$  coupling model. The results are compared with the theoretical results of previous workers and with experimental results. Experimental and theoretical results agree except in the case of  $Cl^{35}$  and  $Cl^{37}$ . (J.S.R.)

### 356

STATISTICAL CALCULATION OF THE DISTRIBUTION OF NUCLEON DENSITIES AND THE SHELL STRUCTURE



OF THE NUCLEUS. L. P. Rapoport and V. A. Filimonov. *Zhur. Eksptl'. i Teoret. Fiz.* 27, 243-50 (1954) Aug. (In Russian)

A statistical calculation of the distribution of nucleon density in the nucleus was made by the Ritz method with two variant parameters. The resulting density distribution was used as the basis of the shell structure of the nucleus. The results agree with the scheme of filling of shells proposed by Mayer. (tr-auth)

### 357

ENERGY LEVELS OF THE  $O^{16}$  NUCLEUS. David M. Dennison (Univ. of Michigan, Ann Arbor). *Phys. Rev.* 96, 378-80 (1954) Oct. 15.

A discussion of the energy levels of the  $O^{16}$  nucleus is given on the basis of an  $\alpha$ -particle model. A considerable number of excited states are calculated under the assumption that the higher order rotation-vibration interactions can be neglected. The positions of the levels depend upon four parameters, three of which relate to the potential while the fourth measures the effective radius of the nucleus. Two possible correlations between the observed and predicted levels are made. The first identification, which appears to be somewhat the more satisfactory, succeeds in correlating sixteen levels in the range from 0 to 13.25 Mev with regard to their positions, angular momenta and parities. Five levels are predicted in the range from 9.5 to 13.8 Mev which do not appear to have been observed. However, three levels have been found in this range but as yet their spins and parities have not been determined and no attempt has been made to assign them. The effective radius of the  $O^{16}$  nucleus is found to be  $2.5 \times 10^{-13}$  cm which is somewhat smaller than might have been expected. (auth)

### 358

TOTAL CROSS SECTIONS OF 208-MEV AND 315-MEV PROTONS FOR LIGHT ELEMENTS. Hervasio G. de Carvalho (Univ. of Chicago, Ill.). *Phys. Rev.* 96, 398-407 (1954) Oct. 15.

Transmission measurements were performed with an external collimated proton beam of The University of Chicago 170-inch synchrocyclotron. Total cross sections of the neutron and ten light elements (H and D, Li, B, Be, C, N, O, Al, S, and Cl) were measured by coincidence and anticoincidence methods at proton energies of 208 and 315 Mev at several subtended angles. The cross sections obtained include all processes except the Coulomb scattering, for which corrections were applied. The corrected cross sections, measured at different subtended angles ("poor geometries") were plotted with their statistical uncertainties as a function of the solid angle subtended or of the angle, and extrapolated to zero degrees ("good geometry"). Only a limited number of previous investigations of the light elements at high particle energies have been made. The results found in the present study for the proton total cross sections for the various elements were comparable to the available published neutron total cross sections measured at the same energies. It was found, by application of the transparent optical model, that cross sections measured were consistent with a nuclear radius  $R = 1.23A^{1/2} \times 10^{-13}$  cm and an absorption coefficient  $K = 0.5 \times 10^{13}$  cm $^{-1}$ .

### 359

NUCLEAR MAGNETIC OCTUPOLE MOMENTS OF THE STABLE GALLIUM ISOTOPES. R. T. Daly, Jr., and J. H.

Holloway (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* 96, 539-40 (1954) Oct. 15.

Three zero-field hyperfine structure intervals in the metastable  $^2P_{3/2}$  state of  $Ga^{69}$  and  $Ga^{71}$  were measured by the atomic-beam resonance method, establishing the existence of nuclear octupole moments. (L.M.T.)

### 360

NUCLEAR SPIN OF  $Np^{239}$ . John G. Conway and Ralph D. McLaughlin (Univ. of California, Berkeley). *Phys. Rev.* 96, 541 (1954) Oct. 15.

Purified  $Np^{239}$  was evaporated on a  $1/4$ -in. graphite electrode and arced at 15 amp d-c. Its spectrum was photographed in the second and third order on a 21-ft Paschen-Runge mount with a 30,000 line/in. grating. A graphite blank,  $Np^{237}$ , and an Fe arc were photographed for comparison. The  $Np^{239}$  hyperfine pattern showed two lines and thus a spin of  $I = 1/2$  ( $h/2\pi$ ) can be assigned. (L.M.T.)

### 361

MEASUREMENT OF THE SPIN AND GYROMAGNETIC RATIO OF  $C^{13}$  BY THE COLLAPSE OF SPIN-SPIN SPLITTING. Virginia Royden (Varian Associates, Palo Alto, Calif.). *Phys. Rev.* 96, 543-4 (1954) Oct. 15.

The proton spectrum of 51%-enriched  $C^{13}$   $H_2I$  was observed at 30 Mc/sec under "slow passage" conditions with a high-resolution spectrometer, the transmitter section of the probe being modified so that it tuned to both 30 and 7.5 Mc/sec simultaneously. The oscilloscope showed three peaks, a central one caused by the  $C^{12}$  protons and two others resulting from the spin-spin interaction of  $C^{13}$  and its companion  $H^1$  nuclei. The number and amplitude of the peaks give a spin of  $1/2$  for  $C^{13}$ , verifying an earlier result by Jenkins (*Phys. Rev.* 72, 169 (1947)). When an auxiliary transmitter was link-coupled into the transmitter section of the probe and its frequency varied slightly around 7.544 Mc/sec, the two side peaks almost completely collapsed and the central peak doubled in amplitude and became quite sharp. The frequency of the auxiliary transmitter at which this occurred was then determined with a frequency counter. A comparison of the resonant frequency of  $C^{13}$  in  $CH_3I$  to that of  $H^1$  in the same molecule gave  $\nu(C^{13})/\nu(H^1) = 0.2514431 \pm 0.0000005$ . (L.M.T.)

### 362

CORRELATION OF SPONTANEOUS FISSION HALF-LIVES. M. H. Studier and J. R. Huizenga (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 96, 545-6 (1954) Oct. 15.

Kramish (*Phys. Rev.* 88, 1201 (1952)) correlated the competition between  $\alpha$  decay and spontaneous fission with the fissionability parameter  $Z^2/A$ , and used a ratio of the spontaneous fission half life to the  $\alpha$ -disintegration half life,  $R$ , to show a relation between consecutive  $\alpha$ -decay products. The authors have observed that linear lines connecting (on semi-log paper) even-even nuclides differing by two  $Z$  units and six  $A$  units give better extrapolated values of  $R$  than linear lines connecting  $\alpha$ -decay products. (L.M.T.)

### 363

SOME PROPERTIES OF NUCLEI OF MASS 19. G. A. Jones, W. R. Phillips, C. M. P. Johnson, and D. H. Wilkinson (Cavendish Lab., Cambridge, England). *Phys. Rev.* 96, 547 (1954) Oct. 15.

Various assignments have been made in the  $F^{19}$ - $Ne^{19}$ - $O^{19}$  system from studies of the positron decay of  $Ne^{19}$  and the  $\beta$  decay of  $O^{19}$ . The Coulomb excitation of  $F^{19}$  by  $\alpha$  particles was also studied but was reported earlier (*Phil. Mag.* 45, 230 (1954)). (L.M.T.)

## 364

NEW LONG-LIVED ISOTOPES OF LEAD. J. R. Huizenga and C. M. Stevens (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 96, 548-50(1954) Oct. 15.

Thallium was bombarded by 21-Mev deuterons and search was made for  $Pb^{202}$  and  $Pb^{206}$  from the reactions  $Tl^{203}(d,3n)$  and  $Tl^{205}(d,2n)$ .  $Pb^{202}$  and  $Pb^{206}$  were detected in approximately 0.07 and 0.04 mole %, respectively. Information obtained on the electron-capture decay processes of the two isotopes is discussed. A half life of  $\sim 3 \times 10^5$  yrs was found for  $Pb^{202}$ , and a lower limit of the half life of  $Pb^{206}$  determined as  $6 \times 10^7$  yrs. (L.M.T.)

## 365

SOME EXPERIMENTS AND THEORETICAL CONSIDERATIONS ON THE ELECTRIC H.F.S. METHOD OF NUCLEAR ALIGNMENT. J. M. Daniels (Univ. of British Columbia, Vancouver). *Can. J. Phys.* 32, 662-73(1954) Oct.

An account is given of two unsuccessful experiments to detect a nuclear electric quadrupole splitting in a solid by essentially thermal methods. In one experiment *p*-difodobenzene was mixed with potassium chromium alum and cooled to 0.01°K by adiabatic demagnetization in an attempt to find the nuclear specific heat of the iodine. In another experiment, a single crystal of cobalt *p*-toluene-sulphonate containing some  $I^{131}$  as *p*-iodobenzenesulphonate was cooled by adiabatic demagnetization, in an attempt to produce an alignment of the  $I^{131}$  nuclei and hence an anisotropic distribution of the emitted  $\gamma$  rays. This is followed by a theory of the relaxation time for the transfer of heat from an assembly of nuclei with a quadrupole splitting to an assembly of paramagnetic ions in the same crystal. The behavior of the relaxation time is discussed with regard to variations of external magnetic field and replacement of the nuclei or the paramagnetic ions with inert entities. A numerical estimate is made of the relaxation time of cobalt/zinc *p*-bromobenzenesulphonate for cobalt concentrations of 100% and 1%. The result of the two experiments is discussed in relation to the theory. An extension of the Casimir and du Pré relations to cover this case is given. (auth)

## 366

OBSERVATION OF PROTON RESONANCE BETWEEN 10 AND 50 KC/S. Jacques Winter, Jean Salmon, Claude Manus, Georges Béné, Pierre Denis, and Richard Extermann. *Compt. rend.* 239, 803-4(1954) Oct. 4. (In French)

A sensitive apparatus is described for detecting the nuclear magnetic resonance of protons. The range of magnetic fields involved is 2 to 5 gauss, and resonances in  $H_2O$ , glycerine, and ferric nitrate were detected. (K.S.)

## 367

ELECTROMAGNETIC PROPERTIES OF DEUTERON. Iwao Sato and Kiyomi Itabashi (Tohoku Univ., Japan). *Progr. Theoret. Phys. (Japan)* 12, 100-3(1954) July.

The magnetic and electric quadrupole moments of the deuteron are calculated, using the pseudoscalar meson theory. (L.M.T.)

## NUCLEAR REACTORS

## 368

Hanford Works

DISTRIBUTION OF THERMAL NEUTRONS FROM FAST SOURCES IN EXPONENTIAL PILES. P. M. Anselone. May 27, 1954. Dec. Sept. 20, 1954. 13p. Contract W-31-109-eng-52 (HW-31925)

In the mathematical analysis of the exponential pile experiment, it is customary to assume that the extraneous sources emit only thermal neutrons. This assumption leads to an expression for the thermal flux which is rather inaccurate near the source plane, with the result that no measurements are made in this region. The effect of a reduction in the number of experimental points is to increase the error in the calculated value of the diffusion length. If the pile is loaded with slugs of high absorbing nonmultiplying material, the neutron attenuation may be so great and the range of measurement so small that any loss in points cannot be tolerated. It is possible to avoid this difficulty by adopting the more accurate assumption that the extraneous sources emit fast neutrons, say all at age zero, so that the derived flux expressions are comparatively accurate even in the neighborhood of the source plane. The procedure involves solving the age equation to determine the distributed thermal neutron source and then using ordinary one-group diffusion theory to find the thermal flux. It is assumed that the pile is essentially homogeneous as far as slowing down properties are concerned. This is the case, for example, if the pile is fully loaded, or, in the case of a partially loaded pile, if the proportion of slug material in a lattice cell is small and if there is no absorption of neutrons above thermal energies by the slug material. (auth)

## 369

Knolls Atomic Power Lab.

ADAPTATION OF MULTIGROUP METHODS TO CYLINDRICAL GEOMETRIES. G. M. Roe. Sept. 27, 1954. 41p. Contract W-31-109-Eng-52. (KAPL-950)

The extension of multigroup calculations to cylindrical reactors requires the solution of a sequence of differential equations of the Helmholtz type with variable coefficients. For an (r,z) geometry the continuum is replaced by a discrete mesh, and the equivalent difference and sum operators are chosen in such a way that exact neutron balance is preserved despite truncation errors. An extrapolated Liebmann iteration scheme is chosen as the most suitable method of solution, and recipes are given for the optimum extrapolation factor. The effect of renormalization on the convergence rate is discussed and illustrated by several test problems. (auth)

## 370

Livermore Research Lab., Calif. Research and Development Co.

NUCLEAR FUEL AND INVENTORY COSTS FOR POWER REACTORS. D. Kallman, R. A. Pierce, and W. S. Scheib, Jr. June 1954. 39p. Contract AT(11-1)-74. (LRL-138)

General expressions and terms have been developed for the purpose of facilitating rapid and consistent initial analyses of fuel and inventory costs for power reactor systems. Although preliminary in nature, the use of these expressions and terms has been illustrated by examples. (auth)

## 371

Oak Ridge National Lab.

THE HRE SIMULATOR. AN ANALOG COMPUTER FOR SOLVING THE KINETIC EQUATIONS OF A HOMOGENEOUS REACTOR. D. M. Collier, L. A. Meeks, and J. P. Palmer. Sept. 24, 1954. 43p. Contract W-7405-eng-26. (ORNL-1572)

The kinetic equations which express reactor power and temperature as functions of time have been derived, and



coefficients appropriate to the Homogeneous Reactor Experiment have been evaluated. These equations are a system of eight simultaneous differential equations, one of which is nonlinear. Since the equations are not readily solvable by any of the usual analytical methods, an electronic analog computer has been developed to solve them for various conditions of operation. Because the computer is to be used for the training of operating personnel, as well as for experimental purposes, it has been necessary to design the device without expansion of the time scale. The computer thus follows, in the same time periods, excursions which are analogous to those encountered in the operation of the reactor. The essential components of the computer include a stable, high-gain, d-c amplifier and an electronic multiplier. For reliable, drift-free operation, a differential system is used. The amplifier has a maximum output of  $\pm 10$  ma at  $\pm 100$  volts, a differential drift of less than 1 mv referred to the input, and a gain of over 20,000. In the electronic multiplier, one variable can cover the range from 1 to 100 volts, while the other variable has a usable range of 5 to 75 volts. Both variables can change at any rate up to 100 cps without causing more than a 2% error in the product. The multiplier output is linear to within 5% over the range from 0.06 to 20 volts. Several conditions of operation for the HRE were investigated. The primary concern is whether the nuclear system is stable for various normal perturbations and for some unusual ones. In every case investigated, the reactor proved to be quite stable. (auth)

372

CALDER HALL. BRITAIN'S FIRST COMMERCIAL-SCALE REACTOR. *Atomics* 5, 275-8; 287(1954) Oct.

A short description of the Calder Hall nuclear power station emphasizes the auxiliary power system design proposed for use in conjunction with a conventional gas-cooled thermal reactor. (K.S.)

373

INTRODUCTION TO NUCLEAR ENGINEERING. Richard Stephenson. New York, McGraw-Hill Book Co., Inc., 1954. xii + 387p.

This book is intended as an introductory survey of the nuclear energy field for engineers. A knowledge of conventional engineering practices is assumed, so that only the unique aspects of nuclear energy are considered. A review of applicable nuclear physics material is provided as an introduction to basic reactor technology. The major portion of the text is devoted to topics on radiation shielding, construction materials, reactor instrumentation, isotope separation, and chemical processing. (K.S.)

374

INTRODUCTION TO NUCLEAR ENGINEERING. Raymond L. Murray. New York, Prentice-Hall, Inc., 1954. xiii + 418p.

A broad coverage of physical and engineering problems encountered in nuclear engineering is presented for junior- and senior-level engineering students. Concise discussions are supplemented by extensive references and problems. Elaborate mathematics are specifically excluded from the text and presented in appendixes. (K.S.)

375

KINETICS OF PILES WITH REFLECTORS. V. H. Rumsey (Ohio State Univ., Columbus). *J. Appl. Phys.* 25, 1395-9 (1954) Nov.

An integral equation for the time-dependent reaction is derived on the basis of the two-group model of neutron multiplication. When the effective multiplication constant is given, the solution reduces to a determination of the mean time  $T$  between consecutive generations, which is largely controlled by the circulation of neutrons in the reflector. If the steady distribution is known,  $T$  can be calculated from a simple formula. To illustrate the orders of magnitude which are involved,  $T$  was calculated for a small pile surrounded by an infinite reflector. A value of  $T = 450 \mu\text{sec}$  was obtained assuming a mean lifetime in the core of  $50 \mu\text{sec}$  and a mean lifetime in the reflector of  $14,000 \mu\text{sec}$ . (auth)

## NUCLEAR TRANSFORMATION

376

Los Alamos Scientific Lab.

$\text{Li}^7(p,n)\text{Be}^7$  REACTION STUDY BY TIME-OF-FLIGHT.

Lawrence Cranberg, R. D. Moffatt, and R. K. Smith. Apr. 12, 1954. Contract W-7405-eng-36. (LA-1654)

Time-of-flight technique has been applied to measurement of the  $\text{Li}^7(p,n)\text{Be}^7$  neutron spectrum at  $0^\circ$  for proton energies from 3.9 to 5.4 Mev in 0.5-Mev steps. The yield corresponding to excitation of the 430-kev level in  $\text{Be}^7$  is about 10% at these energies. No other groups have been found with yields as high as 3% of the ground-state group. Resolution for the main group ranged from 5 to 10%. (auth)

377

Radiation Lab., Univ. of Calif., Berkeley

INTERACTIONS OF 28 MEV PROTONS AND  $\text{He}^4$  (thesis).

Arthur F. Wickersham. Aug. 1954. 75p. Contract W-7405-eng-48. (UCRL-2662)

The reactions of 28-Mev protons and  $\text{He}^4$  have been investigated with a cloud chamber placed in the beam of the Berkeley linear accelerator. The following processes were observed:  $p$ - $\alpha$  elastic scattering,  $\text{He}^4(p, d)\text{He}^3$ ,  $\text{He}^4(p, 2p)\text{H}^3$ , and  $\text{He}^4(p, pn)\text{He}^3$ . Angular distributions were obtained for the first two reactions. Comparison of the yield of the first two reactions with the results of other investigators working with the same accelerating machine permits the assignment of differential cross sections of these first two reactions and total cross sections to the other reactions. Analysis of the rest-frame momentum spectrum of protons from the  $(p, 2p)$  reaction presents no evidence of an excited level in  $\text{He}^4$  in the energy range studied. The reaction  $\text{He}^4(p, p\gamma)\text{He}^4$  was not observed, indicating a cross section less than 2 mb in this energy range. (auth)

378

Radiation Lab., Univ. of Calif., Berkeley

DISINTEGRATION OF OXYGEN BY 300-MEV NEUTRONS

(thesis). Melvin Otis Fuller. Sept. 25, 1954. 61p. Contract W-7405-eng-48. (UCRL-2699)

The 300-Mev neutron beam of the Berkeley cyclotron was used to produce disintegrations of oxygen nuclei in an oxygen-filled cloud chamber situated in a 21,700 gauss pulsed magnetic field. Pictures of the "stars" thus formed were reprojected and measured, permitting identification of most of the ejected particles and computation of their energies and momenta. Each star consisted of one or more tracks due to heavy particles of one or two charges, plus the track of the recoil nucleus. The random selection of 692 stars shows approximate percentages according to

total prongs as follows: 2 prong, 42%; 3 prong, 29%; 4 prong, 12%; 5 prong, 12%; 6 prong, 4%; 7 prong, 1%; plus one 8-prong star. Energy measurements of the prongs showed 29% as having over 15 Mev, 16% over 50 Mev, and 8% over 100 Mev. Using 15 Mev as a division point for slow and fast particles, the slow particles were 37% alphas, 33% protons, and 22% deuterons, and the fast particles 66% protons, 20% deuterons, and 9% alphas. The energy spectra of the slow particles show maxima at about 2, 3, and 4 Mev for the protons, deuterons, and alphas, respectively, and have the general form characteristic of evaporation spectra. The fast particles, mostly protons, exhibit energy and angular distributions similar to those previously found for heavier elements using nuclear cascade theory. The disintegration is interpreted in terms of fast particles due to the nuclear cascade process in combination with evaporation of slow particles from the excited intermediate nucleus remaining after the cascade process. (auth)

### 379

GAMMA RADIATION FROM DEUTERONS ON SEVERAL LIGHT NUCLEI. L. C. Thompson (Rice Inst., Houston, Tex.). *Phys. Rev.* 96, 369-73(1954) Oct. 15

A single crystal NaI scintillation spectrometer has been used to measure the energy of gamma rays from  $B^{10} + d$ ,  $B^{11} + d$ ,  $N^{14} + d$ ,  $C^{12} + d$ ,  $F^{19} + d$ , and  $Si^{28} + d$ . Several gamma rays were found and their energy and relative intensity are given. It is also deduced what transitions these gamma rays represent. (auth)

### 380

PHOTOELECTRIC FISSION OF THE NUCLEUS  $Li^6$ . I Sh. Vashakidze and G. A. Chilashvili. *Zhur. Eksptl. i Teoret. Fiz.* 26, 254-5(1954) Feb. (In Russian)

The  $Li^6(\gamma, d) He^4$  reaction studied experimentally by Glem was examined theoretically. From the reaction threshold, 1.48 Mev, it is believed that the bonding energy of the deuteron to the  $\alpha$  in  $Li^6$  is very small, about 15 Mev. The spin of the parent nucleus is 1, coinciding with the spin of the system  $He^4 + H^2$ . The magnetic moment of  $Li^6$  is almost equal to that of the deuteron. The electric dipole moment of  $He^4 + H^2$  is very small and arises because of difference in mass of an  $\alpha$  particle and two deuterons. The theoretical value of the cross section of the reaction is  $\sigma \sim 0.15 \times 10^{-30} \text{ cm}^2$ , and the experimental value is  $4 \pm 4 \times 10^{-30} \text{ cm}^2$ . (J.S.R.)

### 381

THE SPECTRUM OF CONVERSION ELECTRONS EMITTED IN THE TRANSMUTATION IONIUM ( $Th^{230} \rightarrow$  RADIUM. Salomon Rosenblum, Manuel Valadares, and René Bernas. *Compt. rend.* 239, 759-61(1954) Sept. 27. (In French).

The 67.8-keV radiation from the  $Th^{230} \rightarrow Ra$  transformation is found to be an E2 transition. The contribution of several new radiations to the more penetrating  $\gamma$  rays is discussed. (tr-auth)

### 382

CONTRIBUTION TO THE STUDY OF THE REACTION  $C^{13}(\alpha, n)O^{16}$ . Maurice E. Nahmias and Pierre Savel. *Compt. rend.* 239, 761-2(1954) Sept. 27. (In French).

A study of  $\alpha$  particles emitted by B from neutrons of the  $C^{13}(\alpha, n)O^{16}$  reaction gives a value of  $(10 \pm 1) \times 10^{-27} \text{ cm}^2$  for the effective cross section of this reaction for  $\alpha$  particles of 5 Mev. (K.S.)

### 383

CONTRIBUTION TO THE STUDY OF THE DECAY

SCHEMES OF SOME  $\alpha$  EMITTERS. Paul Falk-Vairant. *Ann. Phys.* 9, 524-81(1954) Sept.-Oct. (In French).

The conversion electrons emitted in the  $\alpha$  disintegrations  $Bi^{211} \rightarrow Ti^{207}$ ,  $Pa \rightarrow Ac$ ,  $Th^{230} \rightarrow Ra$ ;  $Ra \rightarrow Rn$ , and  $Th^{228} \rightarrow Ra^{224}$  were studied. From a measurement of the number of conversion electrons ( $p = 3.0 \pm 0.3 \times 10^{-2}$ ) and of the ratio of the intensity of K to L ( $N_{EK}/N_{EL} = 5.5 \pm 0.5$ ) conversion electrons, it was concluded that the 350-keV  $\gamma$  ray in the  $Bi^{211} \rightarrow Ti^{207}$  decay is a mixture of magnetic dipoles and electric quadrupoles. A complete decay scheme for  $Bi^{211}$ , including spin and parities of the levels, is proposed. In the  $Pa \rightarrow Ac$  decay seven new  $\gamma$  rays were found, and the multipolarity of each ray was determined. A decay scheme for Pa is discussed, but it is not completely satisfactory because of the complexity of the radiation. The number of conversion electrons, corresponding to the de-excitation of the first excited level by  $\alpha_1$  fine structure radiation, were determined for the decays  $Th^{230} \rightarrow Ra$ ,  $Ra \rightarrow Rn$ , and  $Th^{228} \rightarrow Ra^{224}$ . The results obtained ( $p = 0.23 \pm 0.01$  for  $Th^{230}$ ,  $p = 0.03 \pm 0.005$  for Ra, and  $p = 0.25 \pm 0.01$  for  $Th^{228}$ ) indicate that the corresponding  $\gamma$  rays are electric quadrupoles. The theories of  $\alpha$  emission are discussed, and the experimental and theoretical results in detail. (J.S.R.)

### 384

THE ANGULAR DISTRIBUTION OF PROTONS FROM THE  $C^{12}(d, p)C^{13}$  REACTIONS. S. Takemoto, T. Dazai, R. Chiba, S. Ito, S. Suganomata, and Z. Watanabe (Tohoku Univ., Japan). *J. Chem. Soc. Japan* 9, 447-50(1954) Oct.

The angular distributions of protons from the  $C^{12}(d, p)C^{13}$  reactions have been observed at three low bombarding energies, 0.52, 0.63, and 0.84 Mev, using nuclear emulsions at the proton detector. Some details of experimental equipment and procedure are described. The angular distributions observed were then expanded into series of Legendre polynomials. The expansion coefficients are tabulated and also plotted against the bombarding energy together with those reported by other authors. Large asymmetries have been found in the angular distribution curves at these low bombarding energies. (auth)

### 385

THE ANGULAR DISTRIBUTION OF THE  $Li^7(t, \alpha)He^6$  REACTIONS AT 240 KEV TRITON ENERGY. E. Almqvist, T. P. Pepper, and P. Lorrain (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Can. J. Phys.* 32, 621-9(1954) Oct.

The angular distributions of the  $Li^7(t, \alpha)He^6$  reactions have been measured between  $41^\circ$  and  $139^\circ$  to the beam in the laboratory system. The distribution of the 5.95-Mev  $\alpha$  particles associated with the formation of ground state  $He^6$  is of the form  $1 - 0.66(\pm 0.06) \cos^2 \phi$  in the center-of-mass system. The 4.95-Mev  $\alpha$  particles associated with the formation of the first excited state of  $He^6$  are distributed isotropically within  $\pm 8\%$ . These results are consistent with the expectation that the ground state of  $He^6$  has spin 0 and the first excited state spin 2 and suggest that the compound state,  $Be^{10}$ , has  $J = 2$ . (auth)

### 386

STUDIES OF INTERMEDIATE AND HEAVY NUCLEI WITH NEUTRONS. H. H. Barschall (Univ. of Wisconsin, Madison). *Am. J. Phys.* 22, 517-23(1954) Nov.

Experimental results on the interaction of neutrons with intermediate and heavy nuclei are summarized. Until recently the interaction of nucleons with nuclei has usually



been described in terms of the compound nucleus theory. The data presented, however, can not be accounted for by the compound nucleus theory. It appears to be necessary to assume instead that a neutron can traverse a nucleus rather easily with only a small chance of being absorbed into a compound system. Feshbach, Porter, and Weisskopf have proposed an optical potential consisting of a complex square well to account for the experimental data. While this model gives better agreement with the experiments than the compound nucleus theory, it leads to some inconsistencies. In order to be consistent with the results of measurements on neutrons and with the shell model the potential needs to be modified to be deeper than that used by Feshbach et al., and it should contain a spin-orbit coupling term. (auth)

### 387

ON THE ORBITAL ELECTRON CAPTURE IN  $^{195}\text{Au}$ . A. Bisi and L. Zappa (Istituto di Fisica Sperimentale del Politecnico, Milan, Italy). *Nuovo cimento* (9) **12**, 539-47 (1954) Oct. (In English)

The integrating features of the proportional counter spectrometer have been used to investigate the electron capture decay in  $\text{Au}^{195}$ . The transition energies to the excited levels of  $\text{Pt}^{195}$  were found to be  $(E_0)_{d_{3/2} - p_{3/2}} = 143 \pm 17$  kev,  $(E_0)_{d_{5/2} - p_{3/2}} = 172 \pm 17$  kev. The two transitions are classified as once-forbidden ( $\Delta = 0, 1$ , yes). (auth)

## PARTICLE ACCELERATORS

### 388

European Council for Nuclear Research

ON THE ANALYTICAL DETERMINATION OF THE FIELD DISTRIBUTION IN THE RECTANGULAR VERSION OF MODEL 4. E. Regenstreif. Oct. 1954. 13p. (CERN-PS/ER-39)

The field distribution in the air gap of a revised CERN synchrotron magnet design is analyzed by a Schwarz-Christoffel transformation. Infinite permeability and a simplified geometric structure are assumed in the analysis, and further simplifications are made by taking actual structural dimensions into account. The field behavior on the median plane is worked out numerically for comparison with experimental data. (K.S.)

### 389

[European Council for Nuclear Research]

ON THE DESCRIPTION OF THE DYNAMIC BEHAVIOUR OF LAMINATED MAGNETS BY MEANS OF EFFECTIVE FIELDS AND AN EFFECTIVE PERMEABILITY. G. Lüders. 12p. Sept. 1954. (CERN/PS-GL-13)

A simplified concept is introduced which enables flux plots of a laminated magnet to be obtained under dynamic conditions. Assuming that all geometric dimensions are large in comparison with the lamination thickness, it is shown that an effective permeability may be used which is given by  $\mu_{\text{eff}} = (2\delta/a)\mu$ , where  $\delta$  is the defined penetration depth,  $a$  is the laminar thickness, and  $\mu$  is the ordinary iron permeability. (K.S.)

### 390

[European Council for Nuclear Research]

[PAPER 1]. THE ALTERNATING GRADIENT PROTON SYNCHROTRON. 37p. [PAPER 2]. EXPERIMENTAL FACILITIES OF THE CERN PROTON SYNCHROTRON. 27p. July 1954. (CERN-PS/JBA-MGNH/23)

The Alternating Gradient Proton Synchrotron. Design criteria are discussed for an alternating gradient proton

synchrotron in which the frequency of the betatron oscillations are increased by alternating the sign of the gradient of the magnetic field. The structure of the magnet is broken up into sectors whose gradient is alternately positive and negative. Problems associated with the construction of an alternating gradient machine are discussed. Development work at Brookhaven and MIT is compared with work done independently by the CERN group in Europe. Experimental Facilities of the CERN Proton Synchrotron. The building layout and provisions for experiments planned for the CERN proton synchrotron are described. (C.H.)

### 391

[European Council for Nuclear Research]

MESURES DU CHAMP ET DU GRADIENT DU CHAMP DANS UNE SECTION DROITE DU MODELE AC III B. (Measurements of the Field and Field Gradient in a Plane Section of the Model AC III B). P. Denis, B. De Raad, G. Petrucci, L. Resegotti, and A. Sarazin. July 1954. 47p. (CERN-PS/MM-5)

Measurements which have been made on the model AC III B magnet in the focusing and defocusing sections of the synchrotron are reported. The influence of the residual field was analyzed in detail. (tr-auth)

### 392

European Council for Nuclear Research

UTILISATION DE L'EFFET HALL POUR LA PRODUCTION DE FREQUENCES LIEES A LA VALEUR D'UN CHAMP MAGNETIQUE PAR LES FONCTIONS

$$f = kB, f = \frac{k}{B}, f = k \frac{B}{\sqrt{B^2 + B_0^2}}. \quad (\text{Use of the Hall Effect for the}$$

Production of Frequencies Associated with the Value of a Magnetic Field by the Functions

$$f = kB, f = \frac{k}{B}, f = k \frac{B}{\sqrt{B^2 + B_0^2}}). \quad \text{R. Gabillard. Oct. 1954.}$$

11p. (CERN-PS/RGb-6)

Three methods are described for utilizing the Hall effect in order to determine the necessary oscillator frequency which corresponds to a given magnetic field frequency for the CERN synchrotron. (K.S.)

### 393

[European Council for Nuclear Research]

MINUTES OF CERN-PS STAFF MEETING, SEPTEMBER 29, 1954. E. Regenstreif. 6p. (NP-5406)

Equipment described in CERN-PS/RGb-5 and -6 is reviewed. Current research on beam inflection and magnet design for the CERN synchrotron is discussed. (K. S.)

### 394

Rochester Univ.

THE DESIGN OF A FOCUSING AND ANALYZING SYSTEM FOR THE 27" CYCLOTRON BEAM. D. A. Bromley and J. A. Bruner. July 1, 1954. 50p. Contract AT(30-1)-875. (NYO-3823)

### 395

Radiation Lab., Univ. of Calif., Berkeley

AN ALTERNATING-GRADIENT CHANNEL USING PERMANENT BAR MAGNETS. Warren Fenton Stubbins. Sept. 3, 1954. 21p. Contract W-7405-eng-48. (UCRL-2708)

An alternating-gradient channel for containing relativistic electrons (7 Mev) is made by arranging sets of four permanent bar magnets along an evacuated tube. The resultant field in each set is calculated assuming point

magnetic poles. The range of the forcing field linear from the axis of the assembly is determined. The criteria for magnet strengths and set positions are determined. Experimental results of a system are stated. (auth)

### 396

ORBITAL PERIODS IN THE MICROTRON. H. F. Kaiser (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr. 25, 1025-6(1954) Oct.

The period  $T$  of orbital revolutions of an electron in a microtron is such that it must be an integral multiple of the fundamental period  $T_0$  of the r-f resonator which furnishes and accelerates the electrons. The integral relationships have a very large number of possibilities, some of which are discussed here. (auth)

### 397

A SIMPLE THEORETICAL MODEL FOR THE STUDY OF ION MOTION IN A LINEAR ACCELERATOR. Michel-Yves Bernard (Laboratoire de Radioélectricité de l'École Normale supérieure). J. phys. radium 15, 121A-32A(1954) Oct. (In French).

A mathematical model for representing the motion of ions in a linear accelerator is proposed. The motion is described by a simple law for a particle whose phase is constant in relation to the accelerating wave. Parameters are arranged in such a way that the model may be conveniently adapted to known experimental conditions. It is then possible, due to the simplicity of the equations obtained, to carry out an analysis of the ion motion. Longitudinal motion is considered. The equations obtained permit an analysis of the optimum conditions for grouping particles. It is shown, in particular, that a field with decreasing amplitude and given abscissa, gives a very energetic phase grouping, all other factors equal. (tr-auth)

### 398

AMPLITUDES OF OSCILLATIONS IN THE STRONG-FOCUSING SYNCHROTRON. Joseph Seiden. Compt. rend. 239, 798-800(1954) Oct. 4. (In French)

Several equations are derived for calculating the amplitude of particle oscillations in a strong-focusing synchrotron. The stability of closed orbits is treated in connection with magnetic and mechanical perturbations. (K.S.)

### 399

ORBITAL EFFECTS OF THE CORRELATION BETWEEN LENS ALIGNMENT ERRORS IN THE SYNCHROTRON. Joseph Seiden. Compt. rend. 239, 966-8(1954) Oct. 18 (In French)

## RADIATION ABSORPTION AND SCATTERING

### 400

Hanford Works

AGE-DIFFUSION THEORY FOR BETA RAY PROBLEMS. W. C. Roesch. May 24, 1954. 51p. Contract W-31-109-Eng-52. (HW-32121)

Problems of electron transport can be reduced to solution of the diffusion (or age) equation. Numerical calculation of the ages and of the integrals appearing in the solutions of typical problems has given results in good agreement with experiments for the practical range of mono-energetic electrons, the absorption coefficient of beta rays, the surface dose rate of an emitting material in contact with a backscatterer of any atomic number, the dose rate from thin sources as a function of thickness, and the dose rate from point sources. The age-diffusion theory gives in-

accurate results within a mean free path of a localized beta ray source but is otherwise quite accurate. (auth)

### 401

Johns Hopkins Univ.

STUDIES OF NUCLEAR GAMMA RAYS. PROGRESS REPORT [FOR MARCH 1, 1953 TO MAY 31, 1954]. L. Madansky and F. Rasetti. June 1, 1954. 18p. Contract AT(30-1)-1452. (NYO-6072)

The internal bremsstrahlung emitted in electron capture by  $\text{Fe}^{55}$  was studied from 14 kev to the upper energy limit at 220 kev. Fair agreement with the formula of Morrison and Schiff is observed at high energies, whereas a strong rise of the intensity occurs at low energies. The discrepancy may be due to failure of the theory to take into account the effects of nuclear charge, capture of p electrons, and forbiddenness of the transition. (auth)

### 402

Radiation Lab., Univ. of Calif., Berkeley  
RANGE-ENERGY TABLES. Marvin Rich and Richard Madey. Mar. 1954. 433p. Contract W-7405-eng-48. (UCRL-2301)

The tables and graphs of this publication are essentially an expansion of the "Range-Energy Curves" of Aron, Hoffman, and Williams (AECU-663). The original work of Aron et al. is extended to include pions, protons, deuterons, tritons, and  $\text{He}^3$  particles in selected absorber elements and in some compounds that are useful either as target materials or as scintillating materials. This extension is an outgrowth of needs that arose during the course of certain experiments that have been carried on for the past several years at the University of California Radiation Laboratory at Berkeley. Some of the work was done in a random fashion as needed chiefly for pion production experiments with scintillation counters. It seemed worthwhile to unify and complete this work for its utilitarian value to experimenters in high-energy physics, who have found similar needs. The stopping media included in this publication are Be, C, Al, Cu, Pb,  $\text{H}_2$ ,  $\text{D}_2$ , air, CH,  $\text{CH}_2$ ,  $\text{CD}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{D}_2\text{O}$ , plexiglas ( $\text{C}_5\text{H}_8\text{O}_2$ ), trans-stilbene ( $\text{C}_{14}\text{H}_{12}$ ), and phenylcyclohexane ( $\text{C}_{12}\text{H}_{16}$ ). The proton range-energy data for each element except aluminum were taken from Aron et al.; that for aluminum from the article by J. H. Smith (Phys. Rev. 11, 32(1947)). (auth)

### 403

THEORETICAL ANALYSIS OF PION-NUCLEON SCATTERING. Nobuyuki Fukuda (Tokyo Univ. of Education, Japan), Shigeo Goto (Gifu Univ., Japan), and Susumu Okubo and Katuru Sawada (Tokyo Univ., Japan). Prog. Theoret. Phys. (Japan) 12, 79-92(1954) July

Theoretical phase shifts of pion-nucleon scattering are derived assuming the pseudoscalar meson theory with pseudoscalar coupling. In order to make static approximation for such a relativistic coupling, the well-known Tani-Foldy transformation is applied. Since there appears an isotopic-spin-dependent term which is negative and rather strong for the  $T = \frac{1}{2}$  state, theoretical interpretation of recent experiments on the S-wave scattering seems to be hopeful. As to the P-wave scattering, the Tamm-Dancoff approximation and renormalization technique are used. The anomalous magnetic moment of the nucleon is also calculated. The cut-off method is used throughout this work and the results are very sensitive to the cut-off momentum, but the essential features of the theory would be retained qualitatively and, at lower energies, somewhat quantitatively.



D-phase shifts are calculated by the Born approximation, through it is possible that the radiative effects, which always tend to make the nucleon spread out, are very important in this case. (auth)

#### 404

##### HIGH ENERGY NUCLEON SCATTERING BY NUCLEI.

Osamu Kawaguchi, Mitsui Kaway, Yoshihiko Nishida, Mitsuo Sano, and Haruo Ui (Kyoto Univ., Japan). *Progr. Theoret. Phys. (Japan)* **12**, 99-100(1954) July.

The total cross sections and differential cross sections of elastically scattered nucleons by nuclei are analyzed by means of the so-called optical model, using the parameters recently given by Taylor (*Phys. Rev.* **92**, 831(1953)) so as to fit the total cross section data. (auth)

#### 405

A NOTE ON PHOTON-NUCLEON SCATTERING. Yoshio Yamaguchi (Univ. of Illinois, Urbana). *Progr. Theoret. Phys. (Japan)* **12**, 111-12(1954) July.

This note calls attention to the fact that part of the photon-nucleon scattering cross section is so closely related to photomeson production that it can be calculated from the "experimental" cross section of photomeson production. (L.M.T.)

#### 406

ANGULAR DISTRIBUTION AND YIELD OF PROTONS FROM THE  $^{10}\text{B}(\text{d},\text{p})^{11}\text{B}$  REACTION. II. C. H. Paris, F. P. G. Valckx, and P. M. Endt (Univ. of Utrecht, Netherlands). *Physica* **20**, 573-84(1954) Sept. (In English)

In a previous paper (NSA 6-5681) angular distribution measurements were described of four proton groups from the  $\text{B}^{10}(\text{d},\text{p})\text{B}^{11}$  reaction at a deuteron energy of  $E_d = 0.31$  Mev. In the present investigation measurements were added at  $E_d = 0.20, 0.45$ , and  $0.60$  Mev. The differential cross section at  $\delta = 120^\circ$  has also been determined as a function of deuteron energy ( $E_d = 0.175$  to  $0.700$  Mev) by means of a proton scintillation spectrometer. The relative energies of the four proton groups show irregularities at  $E_d = 0.21$  Mev corresponding to a new  $\text{C}^{12}$  resonance level at an excitation energy of  $26.93$  Mev. Angular distributions have been analyzed into a stripping contribution and a contribution from compound nucleus formation. It is shown that the stripping contribution is large for at least two of the four proton groups down to the lowest deuteron energies. The values found by Butler analysis for the angular momentum transfer  $l_n$  are in agreement with known spins and parities. (auth)

#### 407

ANGULAR DISTRIBUTIONS OF FOUR NEUTRON GROUPS FROM THE  $^{10}\text{B}(\text{d},\text{n})^{11}\text{C}$  REACTION. C. H. Paris and P. M. Endt (Univ. of Utrecht, Netherlands). *Physica* **20**, 585-91 (1954) Sept. (In English)

Measurements are described of the angular distributions of the four most energetic neutron groups from the  $\text{B}^{10}(\text{d},\text{n})\text{C}^{11}$  reaction at deuteron energy of  $0.6$  Mev. Neutrons were detected by their recoil protons in nuclear emulsions. The angular distributions have been analyzed in terms of a stripping contribution and an, assumedly isotropic, contribution from compound nucleus formation. From Butler analysis  $l_p = 1$  is found for the stripping contribution of the neutron group leading to the  $\text{C}^{11}$  ground state, and  $l_p = 0$  for the group leading to the second excited state. This is in agreement with previous results obtained from the mirror reaction  $\text{B}^{10}(\text{d},\text{p})\text{B}^{11}$  and with predictions from the

nuclear shell model. Stripping contributions of the other two neutron groups are very small. (auth)

#### 408

ON THE EXPERIMENTAL VERIFICATION OF RANGE-ENERGY RELATIONS FOR NUCLEI OF CHARGE GREATER THAN 2. Jean-Pierre Lonchamp. *Compt. rend.* **239**, 877-9 (1954) Oct. 11. (In French)

A comparison is made between the semi-theoretical range-energy relations previously proposed for ions of charge greater than 2 and experimental values obtained from  $\text{Li}^6$ ,  $\text{B}^8$ , and  $\text{C}^{12}$  tracks. The agreement found is satisfactory. It was found that one point of the range-energy curve for  $\text{C}^{12}$  is  $E = 120.8 \pm 1$  Mev,  $R = 194.7 \pm 1 \mu$  for an Ilford G5 emulsion. (tr-auth)

#### 409

PROTON-PROTON SCATTERING AT INTERMEDIATE ENERGIES. A. Martin and L. Verlet (École Normale Supérieure, Paris, France). *Nuovo cimento* (9) **12**, 483-9(1954) Oct. (In French). (cf. NSA 7-2171)

Proton-proton scattering at intermediate energies has been studied with the potential derived from the ps-ps theory. The validity of the Born approximation in P and D states, and the influence of P-F coupling and of non-perturbation corrections to the potential have been investigated. A comparison with experiment shows a good agreement at  $18.3$  Mev, but a definite disagreement at  $32$  Mev. (auth)

#### 410

THE SCATTERING OF DEUTERONS AND PROTONS BY ALPHA-PARTICLES. R. G. Freemantle, (Univ. of Birmingham, England), T. Grottdal, (Univ. of Bergen, Norway), W. M. Gibson, R. McKeague, (Queen's Univ. of Belfast, Ireland), D. J. Prowse, (Univ. of Bristol, England), and J. Rotblat, (St. Bartholomew's Hospital, London, England). *Phil. Mag.* (7), **45**, 1090(1954) Oct.

#### 411

ON THE SPATIAL DISTRIBUTION OF NEUTRONS SLOWED DOWN IN CARBON AND WATER. Gunnar Holte (Inst. for Mechanics and Mathematical Physics, Uppsala, Sweden). *Arkiv Fysik* **8**, 165-171(1954).

The stationary density of slow, epithermal neutrons around a point source of fast neutrons has been studied. The calculations are made using methods developed in previous papers. Numerical values for the neutron density in homogeneous moderators of carbon and water, respectively, are given in tables and diagrams for different values of the source energy. The validity of the much-used age-theory for these moderators has been studied in detail. For water this theory is practically useless, at least for high energy of the neutron source. (auth)

#### 412

NEUTRON DIFFRACTION STUDY OF LIQUID MERCURY. George H. Vineyard (Univ. of Missouri, Columbia). *J. Chem. Phys.* **22**, 1665-7(1954) Oct.

The neutron diffraction pattern of liquid mercury at  $23^\circ\text{C}$  was measured. The pattern has general resemblance to the x-ray patterns obtained by Debye and Menke and by Jennings, although the angular resolution is not quite as good. The inner peak which has been reported by several investigators is not seen. The radial density function was calculated from the data. (auth)

#### 413

BACKSCATTERING FROM TARGETS OF LOW ATOMIC NUMBER BOMBARDED WITH 1-2 MEV ELECTRONS

Jerome Saldick and Augustine O. Allen (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys. **22**, 1777 (1954) Oct.

An estimation of the fraction of high-energy secondaries, including deflected primaries together with true high-energy secondaries, which would be scattered back from an aqueous solution bombarded with perpendicularly incident 1- and 2-Mev electrons was made, using 0.8N  $\text{H}_2\text{SO}_4$  solutions of Mg, C, Be, and (at 1 Mev only) Li targets. Results showed that the fraction increases nonlinearly with Z in the range of low Z. Data are compared with previous results in which aqueous solutions of Al, Fe, W, Pt, and Pb targets were used. (J.A.G.)

**414**

EMISSION OF PHOTONS OR ELECTRON-POSITRON PAIRS IN MAGNETIC FIELDS. N. P. Klepikov. Zhur. Eksptl.' i Teoret. Fiz. **26**, 19-34(1954) Jan. (In Russian)

By means of the relativistic quantum theory, the phenomenon of electron photoluminescence as well as the emission of photon and electron pairs and single photon annihilation pairs in a magnetic field are examined. The results are correct in very strong magnetic fields when the intensity of electron emission is different from the intensity calculated by the classical theory. (tr-auth)

**415**

COMPARATIVE INVESTIGATION OF THE ABSORPTION OF HIGH ENERGY POSITRONS AND ELECTRONS IN COPPER AND CADMIUM. K. A. Baskova and V. M. Gorbachev. Zhur. Eksptl.' i Teoret. Fiz. **26**, 270-4(1954) Mar. (In Russian)

Results of comparative measurements of the absorption of high-energy positrons and electrons of equal energy by Cu and Cd are given. The observed difference in the absorption increases with an increase in the atomic number of the absorber. (tr-auth)

**416**

POLARIZATION BY SCATTERING OF PROTONS BY PROTONS. Ya. A. Smorodinskii. Zhur. Eksptl.' i Teoret. Fiz. **27**, 123-4(1954) July. (In Russian).

**417**

TRANSFORMATION OF SCATTERING CROSS SECTIONS. P. F. Zweifel and H. Hurwitz, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). J. Appl. Phys. **25**, 1241-5(1954) Oct.

A simple method is presented for the calculation of the transformation matrices between the Legendre polynomial expansion coefficients of the scattering cross section in the laboratory and center-of-mass systems. Approximate expressions for the matrices are given. Applications to transport problems involving the elastic scattering of neutrons are discussed. (auth)

**418**

ELASTIC SCATTERING OF ALPHA PARTICLES BY CARBON. J. W. Bittner and R. D. Moffat (Univ. of Wisconsin, Madison). Phys. Rev. **96**, 374-7(1954) Oct. 15.

By using a propane gas target and 4.0- to 7.6-Mev alpha particles from an electrostatic generator the elastic scattering differential cross section of carbon was measured with high resolution at five angles. A phase-shift analysis of the data indicates levels in  $\text{O}^{16}$  with the following energies, angular momenta, and parities: 10.36 Mev,  $J = 4, +$ ; 11.25 Mev,  $J = 0, +$ ; 11.51 Mev,  $J = 2, +$ ; 11.62 Mev,  $J = 3, -$ ; and 12.43 Mev,  $J = 1, -$ . Reduced widths of the

10.36, 11.25, and 11.62 Mev levels approach the Wigner limit for single-particle excitation. Comparison is made with levels predicted by the alpha-particle nuclear model. (auth)

**419**

INELASTIC NEUTRON SCATTERING IN IRON. D. L. Lafferty, L. A. Rayburn, and T. M. Hahn (Univ. of Kentucky, Lexington). Phys. Rev. **96**, 381(1954) Oct. 15.

The  $\gamma$  spectrum from the inelastic scattering of d-d neutrons in iron has been obtained using an unshielded single-crystal NaI spectrometer. A ring-type geometry permitted subtraction of the background rate from the total rate: this yields a complex spectrum attributed to the inelastic scattering in iron. Energies have been assigned to the peaks of the complex spectrum indicating gamma ray of 2.66, 2.10, 1.76, 1.59, 1.42, 1.24, 0.989, 0.851, 0.634, and 0.462 Mev. (auth)

**420**

INELASTIC SCATTERING OF ALPHA PARTICLES BY LITHIUM. C. W. Li and R. Sherr (California Inst. of Tech. Pasadena). Phys. Rev. **96**, 389-93(1954) Oct. 15.

The inelastic scattering of alpha particles by  $\text{Li}^7$  leading to the formation of the 478-kev state of  $\text{Li}^7$  has been studied by observation of the gamma ray emitted from that state. Singly charged helium ions accelerated by an electrostatic generator were used to determine the yield of the reaction up to an energy of 2.8 Mev. The excitation curve shows a resonance at  $1.889 \pm 0.010$  Mev, with a width of 200 kev and a peak cross section of  $0.11 \pm 0.02$  barn, and another broad resonance at  $2.50 \pm 0.03$  Mev with a peak cross section of  $0.08 \pm 0.015$  barn. These resonances correspond to levels of  $\text{B}^{11}$  at 9.86 Mev and 10.23 Mev. The thick target yield at  $E_\alpha = 2.3$  Mev is  $1.5 \times 10^{-6} \gamma/\alpha$ . The Doppler shift of the emitted gamma ray furnishes an upper limit of the lifetime for the 478-kev excited state of  $\text{Li}^7$ . (auth)

**421**

RANGE OF NITROGEN IONS IN EMULSION. H. L. Reynolds and A. Zucker (Oak Ridge National Lab., Tenn.). Phys. Rev. **96**, 393-4(1954) Oct. 15.

The range of nitrogen ions in Ilford C-2 emulsion was measured for energies from 4 to 28 Mev. The rate of energy loss over this entire energy region is approximately 1.5 Mev per micron. (auth)

**422**

SPATIAL DISTRIBUTION OF ENERGY DISSIPATION BY HIGH-ENERGY X-RAYS. Henry Brysk (National Bureau of Standards, Washington, D. C.). Phys. Rev. **96**, 419-25 (1954) Oct. 15.

The space distribution of energy dissipated by betatron x rays results from the combined propagation of the x rays and of their secondary electrons. This distribution has been calculated for a 40-Mev bremsstrahlung spectrum incident on a mass of water. The calculation is described and the results are compared with related experiments. (auth)

**423**

COULOMB EXCITATION PROCESS IN THE LIGHTER ODD-MASS NUCLEI. G. M. Temmer and N. P. Heydenburg (Carnegie Institution of Washington, D. C.). Phys. Rev. **96**, 426-33(1954) Oct. 15.

The Coulomb excitation functions for thin targets of  $\text{P}^{19}$ ,  $\text{Na}^{23}$ ,  $\text{Ti}^{47}$ ,  $\text{Mn}^{55}$ , and  $\text{Ge}^{73}$ , and for thick targets of  $\text{V}^{51}$  and



$\text{Fe}^{57}$  were studied with alpha particles up to 3.5 Mev; the energy levels excited in these nuclei are at 113 and 196 kev, 446 kev, 160 kev, 128 kev, 68 kev, 320 kev, and 137 kev, respectively. The de-excitation gamma rays from these levels to the ground states were detected except for  $\text{Fe}^{57}$ , where a 123-kev gamma ray is predominantly emitted. In addition, the 182-kev level in  $\text{Zn}^{67}$  was excited, the de-excitation taking place partly by cascade through the 92-kev first excited state. In the cases of  $\text{F}^{18}$  and  $\text{Na}^{23}$  the relative contributions of Coulomb excitation and compound nucleus formation were compared by means of the  $(\alpha, \text{py})$  reactions taking place via the same compound nuclei. In all cases the excitation curves are in fair agreement with the theoretical E2 curves at the lower energies, but show definite deviations in the direction of too much excitation at the higher energies, pointing to some resonant compound-inelastic contribution as well as possible penetration effects not accounted for by the classical theory. The transition probabilities of all transitions are about one-tenth of those in the rare earth region. (auth)

424

ABSORPTION OF POSITIVE PIONS BY DEUTERIUM AT 76 AND 94 MEV. Henry L. Stadler (Univ. of Chicago, Ill.). *Phys. Rev.* **96**, 496-502(1954) Oct. 15.

The absorption of positive pions by liquid deuterium has been studied with scintillation counters, using a collimated pion beam from the Chicago synchrocyclotron. The differential cross sections for the production of protons at angles of  $35^\circ$ ,  $45^\circ$ ,  $60^\circ$ , and  $90^\circ$  are  $1.189 \pm 0.076$ ,  $0.926 \pm 0.058$ ,  $0.643 \pm 0.061$ , and  $0.442 \pm 0.052$  millibarns per steradian at 94 Mev and  $1.010 \pm 0.102$ ,  $0.718 \pm 0.081$ ,  $0.431 \pm 0.073$ , and  $0.300 \pm 0.058$  millibarns per steradian at 76 Mev in the center-of-mass system. The angular distribution can be represented by a  $1 + \cos^2\theta$  with the following values of  $a$ :  $0.268 \pm 0.089$  at 76 Mev and  $0.388 \pm 0.082$  at 94 Mev. The total cross sections are  $7.38 \pm 1.21$  millibarns at 76 Mev and  $9.70 \pm 1.03$  millibarns at 94 Mev. (auth)

425

SCATTERING OF POLARIZED NEUTRONS FROM HEAVY NUCLEI. R. K. Adair, S. E. Darden, and R. E. Fields (Univ. of Wisconsin, Madison). *Phys. Rev.* **96**, 503-7 (1954) Oct. 15.

The polarization of 400-kev  $\text{Li}(p, n)$  neutrons emitted at a laboratory angle of  $50^\circ$  with respect to the incident proton beam was measured to be  $53 \pm 6\%$  by determining the left-right asymmetry in the intensity of neutrons scattered at  $90^\circ$  from oxygen. Oxygen scattering phase shifts necessary for this calculation were derived from the results of previous experiments. Left-right scattering asymmetries were measured for 11 elements, ranging in atomic weight from copper to bismuth. From these asymmetries the magnitudes of the polarizations caused by the heavy nuclei were determined. The variation of the polarization with atomic number appeared similar to that expected from the square well-with-absorption nuclear model of Feshbach, Porter, and Weisskopf, modified by the addition of a spin-orbit term equal to  $-1.5 \text{ Mev} (1 \cdot s)$ . (auth)

426

SCATTERING OF GAMMA RAYS BY NUCLEONS. R. H. Capps and R. G. Sachs (Univ. of Wisconsin, Madison). *Phys. Rev.* **96**, 540-1(1954) Oct. 15.

Sachs and Austern (*Phys. Rev.* **81**, 705(1951)) showed that

the cross section for the scattering of photons of energy  $\hbar\omega$  by any nonrelativistic, bound system in which the number of particles is conserved is proportional to  $\omega^4$  for wavelengths large compared to the dimensions of the system, if Thomson scattering and scattering by the magnetic moment are neglected. In this note it is shown that it is possible to extend the theorem to a much more general class of bound systems, the only condition on the system other than gauge invariance being that its wave function must be normalizable. (L.M.T.)

427

DIFFERENTIAL CROSS-SECTION MEASUREMENTS FOR 1-MEV BREMSSTRAHLUNG. J. W. Motz and William Miller (National Bureau of Standards, Washington, D. C.). *Phys. Rev.* **96**, 544-5(1954) Oct. 15.

The energy and angular distribution of the bremsstrahlung produced in thin targets of Be and Au by 1-Mev electrons was measured with a large  $\text{NaI(Tl)}$  scintillation spectrometer. The differential cross sections obtained for angles of  $10^\circ$ ,  $30^\circ$ , and  $90^\circ$  are shown. (L.M.T.)

## RADIATION EFFECTS

428

Knolls Atomic Power Lab.

X-RAY SCATTERING BY NEUTRON IRRADIATED SINGLE CRYSTALS OF BORON CARBIDE. PART 1. C. W.

Tucker, Jr. and P. Senio. Aug. 16, 1954. 37p. Contract W-31-109-Eng-52. (KAPL-1180)

Neutron irradiation of single crystals of boron carbide produces very strong x-ray-diffraction effects. These effects are contraction of the lattice in the  $c_0$  direction and expansion in the  $a_0$  direction, an anisotropic artificial temperature factor which is six times as strong in the  $c_0$  direction as in the  $a_0$  direction, changes in the average lattice positions of a number of the atoms, and very heavy diffuse scattering surrounding many of the reciprocal lattice points. Annealing experiments show that most of the x-ray effects are removed in the temperature range of  $700$  to  $900^\circ\text{C}$ . The present work shows that the effects are due to the production of an anisotropic defect in the lattice. This defect is produced by the selective removal of the central carbon atom in a chain of three carbon atoms which lies parallel to the  $c_0$  axis. In the  $700$  to  $900^\circ\text{C}$  range, the selectively removed carbon atom becomes mobile and finds its way back to its normal position. The effects are interpreted qualitatively in terms of an elastic model of Huang. (auth)

429

Westinghouse Atomic Power Div.

INFORMATION PERTAINING TO THE USE OF THERMO-COUPLES IN HIGH NEUTRON FLUX. N. J. Palladino. May 24, 1954. Decl. Aug. 30, 1954. 2p. Contract [AT-11-1-GEN-14]. (WAPD-ReS-13)

Results are reported from tests of the effect of neutron flux on thermocouple calibration and on thermocouple insulating materials which indicate that a high neutron flux has no appreciable effect on the thermoelectric properties of a thermocouple but that irradiation does have an adverse effect on the insulation properties of most materials. To date the materials that have proved to be the most satisfactory insulation materials are magnesium oxide, aluminum oxide, lava, and a ceramic insulation material. (C.H.)

## 430

CYCLOTRON TECHNIQUES FOR RADIATION DAMAGE STUDIES. H. P. Yockey, A. Andrew, F. L. Fillmore, L. E. Glasgow, C. d'A Hunt, and J. H. Pepper (North American Aviation, Inc., Downey, Calif.). *Rev. Sci. Instr.* 25, 1011-19(1954) Oct.

This report describes the methods and equipment developed for the irradiation of materials under controlled conditions on the 60-inch Berkeley cyclotron. Descriptions are given of the components of equipment for use in the temperature range from  $-195$  to  $2000^{\circ}\text{C}$ . These include target boxes which accurately locate the specimens to be irradiated in the cyclotron beam, a cold helium circulating system which is used to cool targets to about  $-195^{\circ}\text{C}$ , and a servo temperature controller which automatically regulates the temperature of targets. Typical targets are described along with the conditions of irradiation. The method of determining the spatial distribution of the irradiation intensity is also given. (auth)

## 431

ON THE INFARED-SENSITIVE BEHAVIORS OF SOME DOUBLY ACTIVATED ZnS PHOSPHORS. Sumitada Asano (Okayama Univ., Honshu, Japan). *J. Chem. Soc., Japan* 9, 580-94(1954) Oct.

The quenching and stimulation of phosphorescent brightness under infrared irradiation, and their spectral sensitivities about some ZnS doubly activated phosphors, have been investigated as well as the photocurrents induced simultaneously. A model is proposed which contains two types of electron traps, namely, traps associated with emission levels at the activator and isolated traps. Theoretical calculations based on this model are compared to the experimental results for nonstationary behavior. The comparison shows that nonradiative transitions from the conduction band to the filled band and so-called infrared-sensitive "quasi-direct transitions" from the associated traps to the activators become negligible a few minutes after the ceasing of ultraviolet excitation, and then the proposed theory becomes available exactly. (auth)

## 432

PROBLEMS ENCOUNTERED IN ROUTINE USE OF 10-KILOCURIE, GAMMA-RADIATION SOURCE. John V. Hehemias, L. E. Brownell, W. W. Meinke, and D. E. Harmer (Univ. of Michigan, Ann Arbor). *Am. J. Phys.* 22, 511-16(1954) Nov.

During a year of routine use of a 10-kilocurie, gamma-radiation source, operational problems have been encountered in control of radiation levels in nearby areas, control of pH and clarity of the water in the source storage well, breakdown of organic plastics under prolonged irradiation, and a discrepancy between nominal and apparent source strength. A short discussion of these problems and the resulting changes in operational procedures is presented. (auth)

## 433

EFFECT OF ALPHA-PARTICLE BOMBARDMENT ON CREEP IN CADMIUM SINGLE CRYSTALS. M. J. Makin (Atomic Energy Research Establishment, Harwell, Berks, England). *Nature* 174, 752-3(1954) Oct. 16.

Andrale (*Nature* 156, 113(1954)) found marked increases of glide in stressed Cd single crystals exposed to  $\alpha$  particles and increases in creep rate up to five times by bringing the  $\alpha$  source closer to the crystal during the early stages of the creep curve. The authors repeated Andrale's experiment using an  $\alpha$  source of flux three times as strong

and both standard (99.9% pure) and specpure (99.99%) Cd crystals. In general, no change in creep rate was detectable on bringing the sources closer or removing them from either clean or oxide-coated crystals. In specimens in which marked geometrical softening occurred as glide proceeded, it was observed that the elongation produced by vibration would sometimes cause an increase in creep rate; this increase, however, was independent of the position of the  $\alpha$  sources. Bombarding for longer periods under no load was found to harden the crystal slightly. (L.M.T.)

## RADIOACTIVITY

## 434

Argonne National Lab.

GAMMA-GAMMA ANGULAR CORRELATIONS. F. Coester. Sept. 1954. 29p. Contract W-31-109-eng-38. (ANL-5316)

This report consists essentially of seminar lectures given at Argonne National Laboratory. The emphasis is on methods of derivation rather than on the results which are not new. The connection between the quantum mechanical description and the physical picture is stressed. No attempt has been made to review the voluminous literature on the subject nor to give an account of the historical development. (auth)

## 435

ON THE LINE SHAPE OF MONOCHROMATIC GAMMA RAYS IN SCINTILLATION SPECTROMETERS. D. Maeder, R. Müller, and V. Wintersteiger. Translated by P. R. Gustafson from *Helv. Phys. Acta* 27, 3-44(1954). 41p. (AEC-tr-1974)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 8-3909.

## 436

A 7-SECOND IRIIDIUM ISOMER. F. D. S. Butement and A. J. Poë (Atomic Energy Research Establishment, Harwell, Berks England). *Phil. Mag.* (7), 45, 1090(1954) Oct.

A 7 sec x-ray activity emitting Ir K radiation of energy 0.125 Mev is attributed to Ir<sup>191m</sup>. (K.S.)

## 437

BETA SPECTRA OF C<sup>14</sup> AND S<sup>35</sup>. A. Moljk and S. C. Curran (Glasgow Univ., Scotland). *Phys. Rev.* 96, 395-8 (1954) Oct. 15.

The beta spectrum of carbon 14 was measured with radioactive methane as the source in a proportional counter. To reduce end and side wall effects a pressure of 6 atoms (argon) was employed and a magnetic field of 3500 gauss was applied parallel to the counter axis. The spectrum of sulfur 35 was observed with the same equipment. The theoretical allowed spectrum for this source was modified according to calculations made to take into account the instrumental limitations. The modified theoretical form agreed excellently with the observations down to energies below 5 kev. With the sulphur spectrum as an experimental standard for an allowed shape very accurate empirical correction factors could be obtained, and these were applied to the data for C<sup>14</sup>. The adjusted data for C<sup>14</sup> were found to follow the theoretical shape for an allowed transition to within 1 percent accuracy at energies above about 3 kev. (auth)

## 438

RADIATIONS FROM Ir<sup>192m</sup>. J. P. Mize, M. E. Bunker, and J. W. Starnner (Los Alamos Scientific Lab., New Mexico). *Phys. Rev.* 96, 444-7(1954) Oct. 15.



The photon and electron spectra of  $\text{Ir}^{192\text{m}}$  (1.42 min) have been thoroughly investigated. Study of the photon spectrum with scintillation spectrometers and an aluminum-lined proportional counter spectrometer revealed the presence of a quantum continuum, iridium L x-rays, and a 58-keV gamma ray. The quantum continuum was shown to be bremsstrahlung engendered by conversion electrons from the isomeric transition. Previous to this study, the quantum continuum had been interpreted as possibly caused by "two-quantum" emission. A high-resolution, 180° permanent magnet spectrograph was employed for the examination of the conversion electron spectrum. The energy of the isomeric transition was found to be  $58.0 \pm 0.4$  keV from the conversion electron studies. Lifetime-energy considerations and the observed L-subshell conversion ratios show that the 58.0-keV gamma ray is E3. The L-shell conversion coefficient was determined from scintillation spectrometer data to be  $\geq 870$ . (auth)

#### 439

LONG-LIVED RADIOACTIVITY OF  $\text{Eu}^{152}$  AND  $\text{Eu}^{154}$ . R. E. Slatery, D. C. Lu, and M. L. Wiedenbeck (Univ. of Michigan, Ann Arbor). *Phys. Rev.* **96**, 465-8 (1954) Oct. 15.

The long-lived activity of  $\text{Eu}^{152,154}$  has been examined by means of a thin-lens coincidence spectrometer and a crystal-summing spectrometer, and decay schemes are given. (auth)

#### 440

STUDY OF THE RADIOACTIVITY OF  $\text{Sb}^{124}$ . Jean Moreau. *Compt. rend.* **239**, 800-3 (1954) Oct. 4. (In French)

The energy and intensity of the  $\beta$  spectra of  $\text{Sb}^{124}$  were determined by coincidence magnetic spectrography. The form of the most energetic spectrum agreed with that calculated for a first-order forbiddenness, a spin change of 1, and an STP interaction. (tr-auth)

#### 441

THE NUCLIDE  $\text{Ne}^{19}$  AND THE ft OF MIRROR NUCLEI  $Z = N - 1$ . M. E. Nahmias (Coll. de France, Paris). *J. phys. radium* **15**, 677-8 (1954) Oct. (In French).

The period of  $\beta$  radiation from  $\text{Ne}^{19}$  is found to be  $19 \pm 1$  sec. With  $E_{\text{max}} = 2.3$  MeV,  $\log ft = 3.30$ , which is explained by a reversal of the nuclear configuration. (tr-auth)

#### 442

STUDY OF THE PERIOD OF THE 57 KEV LEVEL ASSOCIATED WITH THE DISINTEGRATION OF  $\text{MTh}_2$ . F. Suzor and G. Charpak (College de France, Paris). *J. phys. radium* **15**, 682-3 (1954) Oct. (In French).

Radiation from a source of  $\text{Ac}^{228}$  was analyzed with a Geiger counter in a  $4\pi$  solid angle. Counter dead time could be varied from  $2.10 \times 10^{-4}$  to 1 sec. From a study of the counting analysis, it is concluded that the period of the 57-keV level is greater than 0.5 sec. (tr-auth)

#### 443

ASSAY OF RADIOACTIVITY BUILD-UP BY "CO-LOG". GRAPHS. A. H. Ward (Univ. of the Gold Coast, Achimota). *Atomica* **5**, 288-9; 294 (1954) Oct.

A graphical method is described for assaying a radioactive product in the presence of its radioactive parent when they are not in equilibrium. (K.S.)

#### 444

RADIOACTIVITY OF THE HUMAN BEING. P. R. J. Burch and F. W. Spiers (Univ. of Leeds, England) and Comments by A. T. Krebs (Army Medical Research Lab.,

Fort Knox, Ky.). *Science* **120**, 719-21 (1954) Oct. 29.

Data are presented on the  $\gamma$ -ray emission from living subjects collected by means of a differential high-pressure ionization chamber apparatus. The contributions of  $\text{K}^{40}$  and of Ra to the natural radioactivity of man are discussed. (C.H.)

#### 445

$\alpha$ -RADIOACTIVITY OF SOME ROCKS AND COMMON MATERIALS. John B. Ockerman and Farrington Daniels (Univ. of Wisconsin, Madison). *J. Phys. Chem.* **58**, 926-7 (1954) Oct.

The  $\alpha$ -ray activity of nearly three hundred samples of material are reported. They include granites, limestones, bentonites, building materials, well water residues, and plant litter. Measurements were made with a scintillometer and range from 0.05 to 12  $\alpha$  counts per hour per sq. cm. from a powder layer of infinite thickness. (auth)

#### 446

K-AUGER ELECTRONS FROM  $\text{Ba}^{137}$ . Toshio Azuma (Naniwa Univ., Mozu, Sakai, Osaka, Japan). *J. Chem. Soc. Japan* **9**, 443-6 (1954) July-Aug.

K-Auger electrons ejected from the L and M levels of  $\text{Ba}^{137}$  were studied by means of a double-coil, magnetic lens beta-ray spectrometer with a thin Zapon film G-M counter. The kinetic energies of those electrons observed were compared with the values evaluated from calculations by Slater's system of screening constants. The relative intensities K-L:L:K-LM:K-MN are estimated to be  $10:5.0 \pm 0.2:0.8 \pm 0.04$ , and the K fluorescence yield  $\omega_K$ ,  $0.85 \pm 0.03$ . (auth)

#### 447

REMARKS ON THE ISOMERS OF 116 ANTIMONY. A. H. W. Aten, Jr., J. Manassen, and G. D. de Feyfer (Institut voor kernfysisch onderzoek, Amsterdam, Netherlands). *Physica* **20**, 665-6 (1954) Sept. (In English)

Irradiation of  $\text{In}_2\text{O}_3$  with  $\text{He}^{+2}$  ions produced  $\text{Sb}^{116}$  in which both a 14-min  $\beta^+$  period and an hour  $\beta^+$  period were observed. The maximum energy of the 14-min isotope was  $E_{\text{max}} = 2.4 \pm 0.2$  MeV. The relative intensities of the 131-, 0.95-, and 0.41-MeV  $\gamma$  rays of the one-hour isotopes were determined. (J.S.R.)

#### 448

ON SOME ISOTOPES OF TECHNETIUM. J. Flegenhelmer and W. Seelmann-Eggebert (Laboratorios de Radioquímica de la Comisión Nacional de la Energía Atómica, Buenos Aires, Argentina). *Z. Naturforsch.* **9A**, 806 (1954) Sept. (In German).

The half life of the  $\text{Tc}^{102}$  daughter of the 11.5-min Mo isotope was measured as  $5 \pm 1$  sec. Bombardment of  $\text{RuO}_2$  with fast neutrons gives a Tc isotope with a half life of  $3.8 \pm 0.2$  min. This is probably  $\text{Tc}^{104}$ . (J.S.R.)

#### SPECTROSCOPY

#### 449

Radiation Lab., Univ. of Calif., Berkeley  
CONSIDERATION OF THE RESOLUTION OF A MAGNETIC-PARTICLE SPECTROMETER. Wilmot N. Hess. June 14, 1954. 18p. Contract W-7405-eng-48. (UCRL-2623)

#### 450

ON THE STARK EFFECT BROADENING OF THE HIGHER BALMER LINES. Wolf-Dieter Henkel. Translated from *Z. Physik* **137**, 295-308 (1954). 11p. (AERE-Trans-11/3/5/445)



The profiles of the lines  $H_\beta$  to  $H_\epsilon$ , as they occur in discharges of hydrogen gas in the pressure range from 25 to 75 mm of mercury and at current strengths up to 200 amperes, have been measured. The calculation of the micro fields from the line contours of the Balmer lines, by applying the Holtsmark theory, leads to values of the field strength which depend on the principal quantum number of the lines under consideration. This dependence can be traced to the fields of the electrons which must be taken into consideration, besides the ionic fields, at high electron densities. Corresponding to the increasing sensitivity of the higher Balmer lines to the Stark effect, the influence of the electrons becomes more strongly apparent with increase of the number of the series. The limiting field strengths at which the effect of the electrons becomes appreciable can be derived from a series of measurements. The results agree very well with an estimation due to Griem. (*Z. Physik.* 137, 280(1954)).

## 451

$\beta$  SPECTROMETER WITH MAGNETIC PRISMS AND ONE MAGNETIC LENS. V. M. Kel'man, N. M. Dusaev, G. S. Malkiel, and N. N. Nevodnickii. *Zhur. Eksptl. i Teoret. Fiz.* 26, 108-9(1954) Jan. (In Russian)

The design and the testing of a  $\beta$  spectrometer analogous to the optical prismatic spectrograph with one lens are described. (tr-auth)

## 452

NOTES ON SOFT X-RAY SPECTRA, PARTICULARLY OF THE Fe GROUP ELEMENTS. H. W. B. Skinner, T. G. Bullen, and J. E. Johnston (Liverpool Univ., England). *Phil. Mag.* (7), 45, 1070-80(1954) Oct.

The paper describes some old unpublished work on the L and M bands of the Fe group metals, and compares the results with new work by Cauchois, Gyorgy and Harvey. A number of differences are discussed. Our results support Farineau's old curves for Cu as against Cauchois', and we are unable to find evidence for the sharp M emission edges found by Gyorgy and Harvey. Some comment is also given about various suggestions on the general interpretation of soft x-ray levels. (auth)

## 453

ISOTOPE SHIFT IN  $\lambda$  4415 Cd II. E. C. Woodward and D. R. Speck (Univ. of California, Berkeley). *Phys. Rev.* 96, 529(1954) Oct. 15.

Suitable mixtures of all the Cd isotopes were studied by means of a Schüller liquid- $N_2$ -cooled hollow-cathode discharge tube as a source, and a Fabry-Perot etalon in conjunction with a large prism spectrograph as the dispersive element. A table of results lists the separations in millikaysers of the lines due to the various isotopes as compared to those of previous workers. Both  $Cd^{111}$  and  $Cd^{113}$  showed only two components in their hyperfine structure. The ratio of magnetic moments of  $Cd^{113}$  to  $Cd^{111}$  was found to be  $1.046 \pm 0.027$ , in good agreement with the value found by Proctor and Yu (*Phys. Rev.* 76, 1728(1949)). (L.M.T.)

## 454

REDETERMINATION OF THE HYPERFINE SPLITTING IN THE GROUND STATE OF ATOMIC HYDROGEN. J. P. Wittke and R. H. Dicke (Palmer Physical Lab., Princeton, N. J.). *Phys. Rev.* 96, 530-1(1954) Oct. 15.

This redetermination utilized a microwave absorption technique employing a resonance line of  $\sim 3$  kc/sec width at half-maximum absorbed power. This width ( $1/6$  of the

normal Doppler breadth) was obtained through the mechanism of collision reduction of the Doppler effect. A value of  $\nu_0 = 1420.40576 \pm 0.00003$  Mc/sec was obtained compared with a value of  $1420.4051 \pm 0.0002$  Mc/sec reported earlier when a molecular beam technique was used (Prodell and Kusch, *Phys. Rev.* 88, 184(1952)). (L.M.T.)

## THEORETICAL PHYSICS

## 455

ACCELERATION OF MOVING CHARGED PARTICLES BY MEANS OF A MAGNETIZED MEDIUM. A. A. Logunov and Ya. P. Terletskii. *Zhur. Eksptl. i Teoret. Fiz.* 26, 129-38(1954) Feb. (In Russian)

The process of acceleration of moving charged particles by means of a magnetized interstellar medium is analyzed. It was established that the increase of the average energy of the particles is proportional to the average energy only at not-too-high energies. When the radius of curvature of the particle trajectories in a magnetic field exceeds the dimensions of the homogeneous regions of the magnetic field, the increase of the particle average energy decreases with increasing energy. The exponential decrease of the energy spectra for the ionic component of primary cosmic radiation in the high energy region is predicted. The break of the spectra of the proton component of primary cosmic rays occurs at a lower energy than the break of the ionic component. (tr-auth)

## 456

EQUATIONS OF SELF-CONSISTENT FIELDS FOR NUCLEI BY THE CALCULATION OF ELECTROSTATIC FORCE. A. S. Kompaneets. *Zhur. Eksptl. i Teoret. Fiz.* 26, 153-8(1954) Feb. (In Russian)

A criterion of the applicability of quasi-classical approximation to self-consistent fields is proposed. The system of equations of self-consistent fields, which describes the distribution of protons and neutrons in the nucleus is derived. (tr-auth)

## 457

APPLICATION OF THE THOMAS-FERMI METHOD TO THE INTRANUCLEAR VIBRATIONS. S. G. Ryzhanov. *Zhur. Eksptl. i Teoret. Fiz.* 26, 264-9(1954) Mar. (In Russian)

The calculation of the nature oscillation of the nucleus agrees with the electrocapillary model, and the frequency of oscillation was calculated. (tr-auth)

## 458

ON THE EFFECTS OF THE OSCILLATION OF THE MESON SHELL OF NUCLEONS ON THE PROBABILITY OF PARTICLE INTERACTIONS. G. A. Askar'yan. *Zhur. Eksptl. i Teoret. Fiz.* 26, 751-4(1954) June. (In Russian)

## 459

ON THE QUESTION OF THE MASS SPECTRA OF ELEMENTARY PARTICLES. P. G. Kard. *Zhur. Eksptl. i Teoret. Fiz.* 27, 259-60(1954) Aug. (In Russian)

## 460

ABSENCE OF DISCRETE ENERGY LEVELS AND COHESIVE STATES OF PARTICLES WITH SPIN  $1/2$  IN A FIXED PSEUDOSCALAR POTENTIAL FIELD. S. I. Pekar. *Doklady Akad. Nauk S.S.S.R.* 97, 1011-12(1954) Aug. 21. (In Russian)

## 461

CROSS-SECTION THEOREM. Robert A. Mapleton. (Air



Research and Development Command, Cambridge, Mass.). *Phys. Rev.* **96**, 415-18(1954) Oct. 15.

A cross-section theorem is derived for systems consisting of several identical particles. The total cross section for all processes; elastic, inelastic, and ionization is given in terms of the imaginary part of a linear combination of direct and exchange forward amplitudes. (auth)

#### 462

NUCLEAR SATURATION AND TWO-BODY FORCES. II. TENSOR FORCES. K. A. Brueckner (Indiana Univ., Bloomington). *Phys. Rev.* **96**, 508-16(1954) Oct. 15. (cf. NSA 8-5446)

The method developed in a previous paper for the treatment of the problem of nuclear saturation has been extended to the case of tensor forces. The general result obtained expresses the many-body potential energy as a function of the triplet and singlet eigen phase shifts for scattering. One consequence is that the tensor force, which averages to zero if Born approximation is used to evaluate the scattering, now gives a very sizable contribution to the potential energy. Phase shifts have been determined for a specific potential model derived from pseudoscalar meson theory, and are shown to give scattering up to 90 Mev which is in good agreement with total cross section and in approximate agreement with angular distributions. Use of these results to evaluate the total energy (neglecting Coulomb effects) in heavy nuclei shows that for a typical case ( $A = 300$ ) saturation occurs at a radius  $1.15 \times 10^{-13} A^{1/3}$  with a binding energy of 10 Mev per particle. If surface effects are neglected, however, the density at saturation increases by a factor of 1.74 with an increase in mean binding energy to 39 Mev. The potential energy per particle has also been determined as a function of its momentum. In the finite nucleus ( $A = 300$ ) the potential depth varies from -82 Mev for a particle of zero momentum to -32 Mev for a particle at the top of the Fermi momentum distribution. Arguments are presented which suggest that this effect is to a large extent independent of the model used. (auth)

#### 463

APPLICATION OF VARIATIONAL PRINCIPLES TO SCATTERING PROBLEMS. H. E. Moses (New York Univ., New York City). *Phys. Rev.* **96**, 519-22(1954) Oct. 15.

The Schwinger and Kohn-Hulthén variational principles are adapted to scattering problems in which only a part of the scattering potential is small. (auth)

#### 464

RADIATIVE EFFECTS IN A CONSTANT FIELD. Roger G. Newton (Institute for Advanced Study, Princeton, N. J.). *Phys. Rev.* **96**, 523-8(1954) Oct. 15.

A method of avoiding all infrared divergencies in the radiative effects of a constant electromagnetic field is developed. It is used, without the necessity of resumming a nonintegrable series, to calculate the one photon mass operator up to the third order in the external field. The magnetic susceptibility and field dependence of the rest mass of an electron are thereby exhibited to lowest order. The result is then shown in a simple way to provide charged particles with strong short-range forces against the Coulomb field. Particles of unrealistically small mass and charge would carry a large repulsive core, if Coulomb attractive, or a large attractive shell, if Coulomb repulsive. (auth)

#### 465

ON A RELATIONSHIP OF ODIOT AND DAUDEL BETWEEN THE ELECTRONIC DENSITY AND ELECTRIC POTENTIAL AROUND AN ATOM. Charles Coulson. *Compt. rend.* **239**, 868-9(1954) Oct. 11. (In French)

It is shown that the Odiot and Daudel relationship between the electronic density and the electric potential around an atom, developed by wave mechanics, may be obtained by the Fermi-Thomas statistical model. (tr-auth)

#### 466

NUCLEAR BINDING ENERGIES AND TWO-BODY FORCE. Wolfgang Wild and Karl Wildermuth (Univ. of München, Germany). *Z. Naturforsch.* **9A**, 799-800(1954) Sept. (In German).

#### URANIUM AND URANIUM COMPOUNDS

#### 467

DETERMINATION OF THE ABSOLUTE FISSION YIELD OF  $Ba^{140}$  IN THERMAL NEUTRON FISSION OF  $U^{235}$ . L. Yaffe, H. G. Thode, W. F. Merritt, R. C. Hawkings, F. Brown, and Rosalie M. Bartholomew (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Can. J. Chem.* **32**, 1017-24(1954) Nov.

The absolute fission yield of  $Ba^{140}$  in the thermal neutron fission of  $U^{235}$  was determined to be  $(6.32 \pm 0.24)\%$ . The reaction  $B^{10}(n, \alpha)Li^7$  was used as a neutron monitor and the  $B^{10}/B^{11}$  ratio determined mass spectrometrically before and after neutron bombardment. The  $Ba^{140}$  disintegration rate was determined using  $4\pi$  counting techniques. The half-life of  $La^{140}$  has been found to be  $40.31 \pm 0.06$  hr. (auth)

